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NUEXCO

OCTOBER 1986 NUMBER 218

MONTHLY REPORT

ON THE NUCLEAR FUEL MARKET

NUEXCO

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MONTHLY REPORT ON THE NUCLEAR FUEL MARKET

October 1986 No. 218

R. WESLEY MILLER, *EDITOR* CLARK M. BEYER, *ASSOCIATE EDITOR*

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To Our Readers

In the *Historical Exchange Values* table on page 32 of Report 187 (March 1984), the January 1976 Exchange Value was listed incorrectly as $32.50. The error was carried over in subsequent Reports. The correct Exchange Value for January 1976, as shown on page 29 of this Report, is $35.20. Nuexco regrets any inconvenience the error may have caused.

* * *

Please note that the address of Nuexco's office in Menlo Park, California has been changed from Building 3, Suite 290 to Building 1, Suite 105. Telephone, telex and telecopy numbers are unchanged. The complete address now is:

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NATURAL URANIUM AND SECONDARY MARKET CONVERSION

(All data as of September 30, 1986)

The **Exchange Value** is **$17.00** per pound U_3O_8, unchanged since last month. **Active supply** of natural uranium (concentrates and UF_6) for spot or near-term delivery totals **4,050,000** pounds U_3O_8 equivalent, down 180 thousand pounds since last month. The corresponding figure for **active demand** is **1,415,000** pounds, down 35 thousand pounds. The spot and near-term **supply-demand ratio** remained at **2.9:1.**

The *Current Market Data* section of this Report lists four natural uranium sales, involving approximately 500 thousand pounds equivalent U_3O_8. All of the transactions involved spot or near-term delivery, and three met the criteria for inclusion in the current Transaction Value calculation. Two of the transactions involved natural UF_6.

The **Transaction Value** is **$17.35** per pound U_3O_8, down $0.10 since last month. The calculation extends over a 3-month period and includes 13 transactions involving 2.4 million pounds equivalent U_3O_8.

The **UF_6 Value** is **$48.00** per kilogram U in UF_6, unchanged since last month.

The **Conversion Value** is **$1.90** per pound U in UF_6, unchanged since last month. Active supply of secondary market conversion services for delivery within three years totals 2.0 million pounds U as UF_6. Active demand totals 650 thousand pounds U as UF_6. No secondary market conversion transactions are reported.

The **Loan Rate** is **4 percent** per annum, unchanged.

* * *

The Exchange Value and UF_6 Value were unchanged this month, in the absence of significant changes in fundamental market forces. While the market appeared to weaken slightly early in September, the September 11 oral arguments in the US producers' lawsuit against DOE may have had some psychological effect on the market, even though no issues were resolved at the hearing. Market participants expecting to be affected by the outcome of the case are naturally quite interested, so the proceedings were widely publicized. The oral arguments by counsel for both sides, as well as the questions and comments offered by each of the three judges, were scrutinized closely for indications as to the ultimate outcome. Toward the end of the month, possibly as a result of speculation that the producers' position had been enhanced, the market firmed at the level of the previous month, $17.00 per pound U_3O_8 and $48.00 per kgU as UF_6.

Canadian producers continue to dominate the seller side of the market, but now seem less willing to cut prices drastically to complete a transaction. In addition, large discounts on uranium of Southern African origin may have been discontinued, effectively removing from the market any material of that origin. Such an event would undoubtedly alleviate some of the downward price pressure that has been building. As is customary in this market, discounts and premiums relative to the Exchange Value or UF_6 Value may be associated with material origin, location, form, time of payment, currency of payment, or other commercial terms and conditions.

One US producer sold a significant quantity of material at a slight premium during September, but buyers remain reluctant to pursue the purchase of US-origin material being offered at $19-$20 per pound U_3O_8. In general, US utilities probably will delay buying decisions as long as possible, hoping for some resolution to the market uncertainties associated with the current litigation and legislative actions. However, US producers may be inclined to view the market for US-origin uranium as stronger now than in the past few months, because of their assessment of the likely outcome in Albuquerque and because of the unexpected support given to the Domenici legislation by the Chief Executive Officers committee of the Edison Electric Institute, a utility trade organization. The utility endorsement of the amended, less complex Domenici bill gives the bill a much greater chance of passage, thereby increasing the likelihood that uranium usage restrictions of 40 to 50 percent will be implemented within one year.

While European buyers have been largely inactive in the last few months because of the general lack of unfilled requirements, some continue to make occasional purchases. One buyer purchased non-US origin material at a price slightly below the Exchange Value, but the results of that bidding indicate that most non-US sellers are not prepared to cut prices aggressively at present.

* * *

The Conversion Value was unchanged this month, although the supply of secondary market conversion services increased as two sellers became active. While demand increased as at least two buyers prepared to issue secondary market bid requests, buyers remain largely discretionary. Thus, because no potential sellers appear willing to cut prices to complete a sale, the market may remain inactive. Some of the active sellers have primary conversion contracts priced well above the current Conversion Value, so there is little economic incentive for those utilities to enter agreements on the secondary market unless they can realize prices well above the current level.

* * *

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ENRICHED URANIUM AND SWUS

The **SWU Value** as of September 30, 1986, is $78 per SWU, unchanged since last month. This refers to SWU at a tails assay of 0.30 weight-percent U_{235} and for delivery within one year. Three secondary market SWU transactions are reported this month, involving less than 50 thousand SWU of DOE origin.

The current secondary market for enrichment services appears to have divided into two categories. The three transactions for small quantities of DOE-origin SWU that took place during September represent one segment of that market. Some utilities are holding small quantities of DOE-origin virgin SWUs — so-called upgrade SWUs that are more valuable because they can be used to upgrade the enrichment assay of larger amounts of enriched product. These SWUs usually can be obtained at prices in the range of $85 to $100 per SWU. However, because requirements-type commitments have been replacing fixed commitments from DOE, utilities use up excess inventories, so these opportunities make up a diminishing segment of the market. The other segment consists of SWUs contained in enriched product (usually at any of several common enrichment assay levels). These opportunities are typically available in much larger quantities (on the order of 100,000 to 300,000 SWUs), and command prices near the current SWU Value.

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THE CONTINUING DECLINE OF URANIUM SPOT PRICES IN EUROPEAN AND JAPANESE CURRENCIES

The US dollar continued to decline during September against key European currencies and the Japanese yen, reaching its lowest point in several years. The result was a continuing decline of uranium spot prices expressed in those currencies. The $17.00 Exchange Value was equivalent to 34.32 Deutschmarks or 2,608 Japanese yen on September 30. These figures represent substantial declines compared to 41.87 DM and 3,413 yen when the Exchange Value reached $17.00 on December 31, 1985. Furthermore, when the Exchange Value fell to a ten-year low of $14.25 on April 30, 1985, it equalled 44.36 marks and 3,598 yen. Thus, while dollar-denominated uranium prices have risen a cumulative 19 percent since the Exchange Value bottomed in April 1985, uranium prices in Deutschmarks have fallen 23 percent, and prices in yen have fallen 28 percent (Table 1 and Figure 1).

The dollar rose steadily against the Deutschmark and the yen during 1984 as the US economy strengthened and expanded. It peaked in early 1985 and has declined steadily since then. Three principal reasons for the consistent downward trend of the US dollar relative to other currencies are the following.

1. The strong dollar in 1984, which increased the competitiveness of non-US companies in international markets, led to a competitive resurgence in European and Japanese economies and drew investment capital away from the USA.

2. The Reagan Administration, in coordinated action with European and Japanese governments, over the past year has taken steps to reduce the dollar's value. This was done to counteract record US trade deficits in lieu of protectionist trade measures proposed by the US Congress.

3. Despite the rapid decline in the dollar's value, confidence in the European and Japanese economies has remained high relative to the USA, where foreign trade deficits continue to dampen the US economy and many analysts predict further recession.

For many uranium market participants, the recovery of the dollar is of prime importance, even if the Exchange Value rises gradually over time. Some non-US sellers that have dollar-denominated contracts or that participate in the spot market are distressed by the dollar's entrenched weakness, and are anxious for a recovery. Conversely, many non-US buyers are witnessing lower spot prices almost every month despite the almost 20-percent rise in the Exchange Value (expressed in US dollars) over the last 18 months. Those buyers must decide at what point to take advantage of this bargain situation.

Table 1
EXCHANGE VALUE EXPRESSED IN US DOLLARS, GERMAN MARKS AND JAPANESE YEN SINCE APRIL 1985[1]

Date Determined	US Dollar	Cumulative Change[2] (percent)	German Mark	Cumulative Change[2] (percent)	Japanese Yen	Cumulative Change[2] (percent)
Apr 30 1985	14.25	—	44.36	—	3,598	—
May 31 1985	15.00	+ 5.3	46.30	+ 4.4	3,773	+ 4.9
Jun 30 1985	15.00	+ 5.3	45.76	+ 3.2	3,732	+ 3.7
Jul 31 1985	15.75	+10.5	44.50	+ 0.2	3,739	+ 3.9
Aug 31 1985	16.00	+12.3	44.46	+ 0.2	3,793	+ 5.4
Sep 30 1985	16.00	+12.3	42.94	− 3.2	3,458	− 3.9
Oct 31 1985	16.50	+15.8	43.43	− 2.1	3,507	− 2.5
Nov 30 1985	16.75	+17.5	42.62	− 3.9	3,368	− 6.4
Dec 31 1985	17.00	+19.3	41.87	− 5.6	3,413	− 5.1
Jan 31 1986	17.00	+19.3	40.38	− 9.0	3,275	− 9.0
Feb 28 1986	17.00	+19.3	37.89	−14.6	3,082	−14.3
Mar 31 1986	17.25	+21.1	40.19	− 9.4	3,098	−13.9
Apr 30 1986	17.25	+21.1	37.51	−15.4	2,893	−19.6
May 31 1986	17.00	+19.3	39.21	−11.6	2,923	−18.8
Jun 30 1986	17.00	+19.3	37.43	−15.6	2,810	−21.9
Jul 31 1986	17.00	+19.3	35.89	−19.1	2,640	−26.6
Aug 31 1986	17.00	+19.3	34.86	−21.4	2,651	−26.3
Sep 30 1986	17.00	+19.3	34.32	−22.6	2,608	−27.5
TOTAL NET CHANGE		+19.3		−22.6		−27.5

[1]Calculated using currency exchange rates published in the *Wall Street Journal* as of the given day.
[2]Using the April 30, 1985 Exchange Value ($14.25) as a base.

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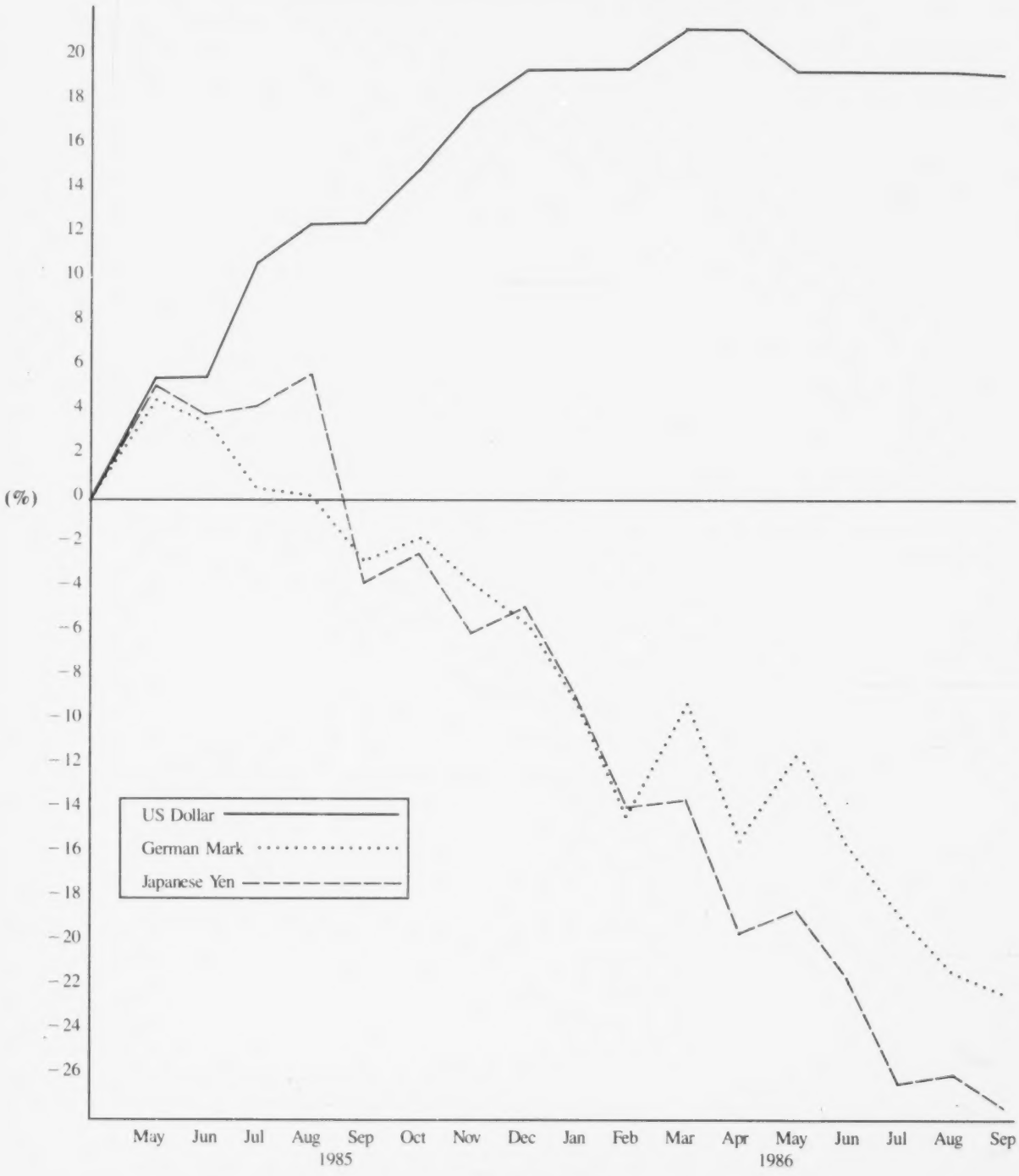
FIGURE 1. Cumulative Change in Exchange Value Since April 30, 1985
(Expressed in US Dollars, German Marks, and Japanese Yen)



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CURRENT MARKET DATA

September 30, 1986	Market Values	Active Supply[1] (thousands)	Active Demand[1] (thousands)
EXCHANGE VALUE	**$17.00**/lb. U_3O_8	4,050	1,415
UF_6 VALUE	**$48.00**/kgU		
CONVERSION VALUE	**$1.90**/lb. U as UF_6	1,965	650
SWU VALUE 0.3 tails assay; delivery within one year	**$78**/SWU		
LOAN RATE	**4%**/annum	0	0

	$/lb. U_3O_8	Millions of Pounds	Number of Transactions	Number of Months
TRANSACTION VALUE	**17.35**	2.4	13	3

[1]Supply and demand tables in *Current Market Data* section of this Report detail the numbers for each category.

DEFINITIONS

1. The **Exchange Value** is Nuexco's judgment of the price at which transactions for significant quantities of natural uranium concentrates could be concluded as of the date indicated.
2. The **UF_6 Value** is Nuexco's judgment of the price at which spot and near-term transactions for significant quantities of natural uranium hexafluoride could be concluded as of the date indicated.
3. The **Conversion Value** is Nuexco's judgment of the price at which spot and near-term transactions for significant quantities of conversion services could be concluded in the secondary market as of the date indicated.
4. The **SWU Value** represents Nuexco's judgment of the price at which transactions for the sale of significant quantities of SWUs of stated origin for delivery in the specified time period could be concluded as of the date indicated.
5. The **Loan Rate** is Nuexco's judgment of the annual interest rate at which uranium loans could be concluded as of the date indicated.
6. The **Transaction Value** is a weighted average price of recent natural uranium sales transactions. The calculation is based on prices paid in:
   a. Transactions closed within the previous three-month period for which delivery is scheduled within one year of the transaction date;
   b. At least ten transactions;
   c. Transactions involving a sum total of at least 2 million pounds U_3O_8 equivalent.

   The sample time is extended as necessary to include these minima. Other currencies are converted to US dollars using conversion rates in effect on or near the transaction date.

DERIVATIONS AND COMMENTS

1. All Market Values are based on:
   a. Data from recently completed transactions.
   b. Data from pending transactions.
   c. Firm bids to buy or borrow, and firm offers to sell or lend.
   d. Prices purchasers or rates borrowers have expressed a willingness to pay, but for which Nuexco is not aware of firm bids to buy or borrow, and prices sellers or rates lenders have expressed a willingness to accept, but for which Nuexco is not aware of firm offers to sell or lend.
2. Prices associated with deliveries under old or renegotiated contracts or other than arm's-length transactions are not included in the determination of these Market Values.
3. In the determination of the Conversion Value, Nuexco does not consider transportation charges other than those customarily provided by primary suppliers of conversion services.
4. The prices of conversion services or SWUs delivered under long-term contracts with primary suppliers are not considered in the determination of either the Conversion Value or SWU Value.
5. For the SWU Value, Nuexco converts SWU prices at varying tails and product assays to equivalent SWU prices at a tails assay of 0.30 weight-percent U_{235} and a product assay of 3.0 weight-percent U_{235}, assuming feed costs corresponding to the Nuexco Exchange and Conversion Values determined as of the same date.
6. In calculating the Transaction Value, Nuexco does not account for the price of uranium delivered in connection with contracts which call for "market price" mechanisms. This exclusion applies particularly to contracts in which delivery prices are expressed as a function of future Exchange Values or any other indeterminate variable. Also excluded from the calculation are any other transactions in which the delivery price is defined in such a way that it cannot currently be determined.

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CURRENT MARKET DATA

EXCHANGE VALUE EXPRESSED IN SELECTED PRODUCER & CONSUMER CURRENCIES[1]

Country (currency)	per lb. U_3O_8 in Concentrates			per kg. U in Concentrates		
	This Month (Sep 30, 1986)	Last Month (Aug 31, 1986)	12 Months Ago (Sep 30, 1985)	This Month (Sep 30, 1986)	Last Month (Aug 31, 1986)	12 Months Ago (Sep 30, 1985)
Australia (dollar)	27.06	27.91	22.79	70.34	72.55	59.25
Belgium (comm. franc)	714.29	720.03	866.27	1,857	1,872	2,252
Canada (dollar)	23.58	23.66	21.98	61.32	61.51	57.15
Finland (markka)	83.37	83.50	91.90	216.75	217.07	238.92
France (franc)	112.29	114.25	130.61	291.92	297.02	339.56
FRG (mark)	34.32	34.86	42.94	89.21	90.64	111.64
Italy (lira)	23,800	24,021	29,154	61,873	62,450	75,795
Japan (yen)	2,608	2,651	3,458	6,780	6,893	8,991
Netherlands (guilder)	38.90	39.26	48.28	101.14	102.07	125.52
South Africa (rand)	37.53	43.93	40.30	97.56	114.20	104.78
Spain (peseta)	2,269	2,274	2,611	5,900	5,911	6,789
Sweden (krona)	117.48	117.57	128.51	305.43	305.64	334.11
Switzerland (franc)	27.81	28.13	35.15	72.31	73.12	91.38
UK (pound)	11.85	11.49	11.37	30.80	29.87	29.55
US (dollar)	17.00	17.00	16.00	44.20	44.20	41.60

TRANSACTION VALUE EXPRESSED IN SELECTED PRODUCER & CONSUMER CURRENCIES[1]

Country (currency)	per lb. U_3O_8 in Concentrates			per kg. U in Concentrates		
	This Month (Sep 30, 1986)	Last Month (Aug 31, 1986)	12 Months Ago (Sep 30, 1985)	This Month (Sep 30, 1986)	Last Month (Aug 31, 1986)	12 Months Ago (Sep 30, 1985)
Australia (dollar)	27.61	28.64	21.51	71.79	74.47	55.92
Belgium (comm. franc)	728.99	739.09	817.54	1,895	1,921	2,125
Canada (dollar)	24.07	24.29	20.74	62.58	63.14	53.93
Finland (markka)	85.09	85.71	86.73	221.22	222.82	225.48
France (franc)	114.60	117.27	123.27	297.93	304.88	320.46
FRG (mark)	35.02	35.79	40.53	91.05	93.04	105.36
Italy (lira)	24,290	24,657	27,514	63,147	64,104	71,531
Japan (yen)	2,661	2,721	3,264	6,919	7,075	8,486
Netherlands (guilder)	39.70	40.30	45.56	103.22	104.77	118.46
South Africa (rand)	38.30	45.09	38.04	99.57	117.22	98.88
Spain (peseta)	2,316	2,334	2,464	6,021	6,067	6,407
Sweden (krona)	119.90	120.68	121.29	311.72	313.74	315.31
Switzerland (franc)	28.39	28.87	33.17	73.80	75.06	86.24
UK (pound)	12.09	11.79	10.73	31.43	30.66	27.89
US (dollar)	17.35	17.45	15.10	45.11	45.37	39.26

[1]Calculated using currency exchange rates published in the *Wall Street Journal* on Sept. 30, 1986.

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CONVERSION VALUE EXPRESSED IN SELECTED PRODUCER & CONSUMER CURRENCIES[1]

Country (currency)	per lb. U as UF_6			per kg. U as UF_6		
	This Month (Sep 30, 1986)	Last Month (Aug 31, 1986)	12 Months Ago (Sep 30, 1985)	This Month (Sep 30, 1986)	Last Month (Aug 31, 1986)	12 Months Ago (Sep 30, 1985)
Australia (dollar)	3.02	3.12	2.28	6.67	6.88	5.02
Belgium (comm. franc)	79.83	80.47	86.63	176.00	177.42	190.98
Canada (dollar)	2.64	2.64	2.20	5.81	5.83	4.85
Finland (markka)	9.32	9.33	9.19	20.54	20.57	20.26
France (franc)	12.55	12.77	13.06	27.67	28.15	28.80
FRG (mark)	3.84	3.90	4.29	8.46	8.59	9.47
Italy (lira)	2,660	2,685	2,915	5,864	5,919	6,427
Japan (yen)	291.46	296.32	345.87	642.55	653.27	762.51
Netherlands (guilder)	4.35	4.39	4.83	9.59	9.67	10.64
South Africa (rand)	4.19	4.91	4.03	9.25	10.82	8.89
Spain (peseta)	253.64	254.11	261.14	559.17	560.22	575.71
Sweden (krona)	13.13	13.14	12.85	28.95	28.97	28.33
Switzerland (franc)	3.11	3.14	3.51	6.85	6.93	7.75
UK (pound)	1.32	1.28	1.14	2.92	2.83	2.51
US (dollar)	1.90	1.90	1.60	4.19	4.19	3.53

SWU VALUE AND UF_6 VALUE EXPRESSED IN SELECTED PRODUCER & CONSUMER CURRENCIES[1]

Country (currency)	SWU Value delivery within one year (Sep 30, 1986)	UF_6 Value per kg.U in UF_6 This Month (Sep 30, 1986)	UF_6 Value per kg.U in UF_6 Last Month (Aug 31, 1986)
Australia (dollar)	124.14	76.40	78.79
Belgium (comm. franc)	3,277	2,017	2,033
Canada (dollar)	108.21	66.59	66.81
Finland (markka)	382.54	235.41	235.76
France (franc)	515.19	317.04	322.58
FRG (mark)	157.45	96.89	98.44
Italy (lira)	109,198	67,199	67,825
Japan (yen)	11,965	7,363	7,486
Netherlands (guilder)	178.49	109.84	110.85
South Africa (rand)	172.19	105.96	124.03
Spain (peseta)	10,412	6,408	6,420
Sweden (krona)	539.05	331.72	331.95
Switzerland (franc)	127.62	78.53	79.42
UK (pound)	54.36	33.45	32.44
US (dollar)	78.00	48.00	48.00

[1]Calculated using currency exchange rates published in the *Wall Street Journal* on Sept. 30, 1986.

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CURRENT MARKET DATA

RECENT TRANSACTIONS[1]

Uranium Sales

Nuexco Transaction Number	Delivery Period	Approximate Quantity (thousands of pounds, U_3O_8 equivalent)	Approximate Price as Percent of Current Exchange or UF_6 Value	Seller	Buyer	Remarks
3807	1986	50-100	103	Producer	Utility	
3803	1986	50-100	99	Producer	Utility	UF_6.
3802	1987	101-300	99-100	Producer	Utility	
3795	1986	50-100	R[5]	Producer	Utility	UF_6.

Enrichment Services
Secondary Market Sales

Nuexco Transaction Number	Delivery Period	Approximate Quantity[2] (thousands of SWUs)	Approximate Price[3] as Percent of Current SWU Value[4]	Seller	Buyer	SWU Origin	Remarks
3806	1987	less than 50	R[5]	Utility	Utility	DOE	
3800	1987	less than 50	109	Trader	Utility	DOE	
3796	1987	less than 50	106	Utility	Trader	DOE	

[1]Transactions listed are not limited to those in which Nuexco was involved, but also include others of which Nuexco is aware.
[2]If tails assay is unknown or unspecified, Nuexco's calculation of SWU quantity assumes 0.20 w/o tails assay.
[3]Price is not normalized to 0.20% tails assay.
[4]Refers to SWU Value that corresponds to SWUs included in transaction. When prices and SWU values are expressed as discounts (e.g., X dollars less than DOE's USEC base price at time of delivery), the percentage refers to the ratio of the *discounts*, not the ratio of the prices.
[5]The notation *R* means that Nuexco either does not know, or that Nuexco has restricted that information to protect client confidentiality.

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URANIUM SUPPLY
(September 30, 1986)

Nuexco Project Number	Delivery Period[1] (Thousands of Pounds U_3O_8) Spot or Near-term[2]	Intermediate or long-term	Remarks
Available for Sale:			
ACTIVE			
2335	400	—	
2740	100	—	
2764	260	—	UF_6
2777	500	—	
2885B	325	—	UF_6
2889	100	—	
2933*	300	300 per year	1988-90
2967*	200	—	
2973	15	—	
2989	40	—	
3023	500	500	UF_6
3121	1,200	—	
3127*	110	—	
2263*	—	400 per year	1988 on
2625*	—	500 per year	1988 on
2781	—	250 per year	1988-95
2927*	—	220 per year	1988-90
2981	—	600 per year	1988-91
TOTAL:	4,050		
INACTIVE			
2297	200	200 per year	1988-89
2336*	250	250 per year	1988-94
2389*	75	75 per year	1988-90
TOTAL:	525		

*New or revised since last month.

[1] Measured from the date of this Report.

[2] For delivery within one year. This category excludes material deliverable within one year under other than spot or near-term contracts.

Projects removed since last month: 2703, 2765, 2810, 2813.

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CURRENT MARKET DATA

URANIUM DEMAND
(September 30, 1986)

Nuexco Project Number	Delivery Period[1] (Thousands of Pounds U_3O_8) Spot or Near-term[2]	Intermediate or long-term	Remarks
Inquiries to Purchase:			
ACTIVE			
2782*	900	700	UF_6 or U_3O_8; 1988
2784	100	—	
2948*	100	—	UF_6
2954*	50	1,000 per year	1987-90
2955*	265	—	
2738	—	1,000	1989 on
2739*	—	1,000 per year	1987-90
3019	—	200	1988-91
TOTAL:	1,415		
INACTIVE			
2760*	750	750 per year	1988-90
2798	70	—	
2877	300	—	
2893	200	—	
2681	—	500	UF_6 or U_3O_8; 1988
2936*	—	400 per year	1988-95
TOTAL:	1,320		

*New or revised since last month.
[1]Measured from the date of this Report.
[2]For delivery within one year. This category excludes material deliverable within one year under other than spot or near-term contracts.
Projects removed since last month: 2661, 2733, 2857, 2898, 2951, 3014, 3018.

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LOAN SUPPLY AND DEMAND
(September 30, 1986)

Nuexco Project Number	Delivery Period[1] (Thousands of Pounds U_3O_8) Within 1 Year	Beyond 1 Year	Remarks
Available for Loan:			
INACTIVE			
1938	3,000	—	UF_6
2036	500	—	
2667	800	—	
2920	2,000	—	
TOTAL:	5,300		

*New or revised since last month.
[1]Measured from the date of this Report.
Projects removed since last month: None.

No inquiries to borrow are reported this month.

CONVERSION SUPPLY AND DEMAND
(September 30, 1986)

Nuexco Project Number	Delivery Period[1] (Thousands of Pounds U as UF_6) Within 3 Years	Beyond 3 Years	Remarks
Available for Sale:			
ACTIVE			
2849	550	500	1987-90
2859	750	750	
2935*	500	—	
2988*	165	—	
TOTAL:	1,965		
Inquiries to Purchase:			
ACTIVE			
2833	400	—	
2949*	250	—	
TOTAL:	650		

*New or revised since last month.
[1]Measured from the date of this Report.
Projects removed since last month: 2931.

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CURRENT MARKET DATA

SWU SUPPLY AND DEMAND
(September 30, 1986)

Nuexco Project Number	Delivery Period[1] (Thousands of SWUs) Spot or Near-term[2]	Intermediate or Long-term	Remarks
Available for Sale:			
ACTIVE			
2571	—	55	1987
2855	250	—	
TOTAL:	250		
INACTIVE			
2410A	340	—	
2873	40	—	
2953	200	—	
TOTAL:	580		
Inquiries to Purchase:			
INACTIVE			
2878	60	—	
2879	250	—	
2923*	15	—	
2999	—	300	
3015	85	—	
TOTAL:	410		

*New or revised since last month.
[1]Measured from the date of this Report.
[2]For delivery within one year. This category excludes SWUs deliverable within one year under other than spot or near-term contracts.
Projects removed since last month: 3026.

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THE TAILS ASSAY SWAP

Introduction

In the past few years, one of the mechanisms used to facilitate transactions involving uranium and enrichment services has been the tails assay swap. While the advent of the Utility Services Enrichment Contract (USEC) has, in most cases, eliminated the advantages of the tails assay swap, there are still some utilities which could benefit from the technique, in that it can enable a utility to exchange some of its natural uranium inventory for enrichment services, thereby reducing the amount of cash needed to procure a given amount of nuclear fuel. In the tails assay swap, a utility with a fixed SWU commitment from DOE delivers excess natural feed to DOE, fixes the tails assay, and then sells the SWU component of the excess enriched product at competitive prices on the secondary market. This article explains the process and provides examples of how utilities and intermediaries have performed such transactions in the past.

Background

Both primary and secondary market enrichment transactions are based on the concept of exchanging feed material (natural UF_6) plus cash for enriched UF_6 product. Most fuel for commercial nuclear power plants requires enrichments (product assays) in the range of approximately two to four weight-percent (w/o) U_{235}. The weight-percent of U_{235} in the waste stream is referred to as the tails assay, and it generally varies between 0.2 and 0.3 w/o U_{235}. Although the *physical* tails assay is fixed at the enrichment plant, there is a *transaction* tails assay for any enrichment transaction that determines in what relationship the feed and money (for SWUs) will be given to the enricher for the desired quantity of product.

Because of the relationship between feed quantity, product assay, and tails assay, higher tails assays require more natural uranium feed (and fewer SWUs) to produce a given quantity of enriched product at a given product assay. Conversely, lower tails assays require less natural feed (and more SWUs) to produce the same quantity of enriched product at the same product assay. Thus, depending on the relative costs of enrichment services and a utility's uranium costs, the utility can determine its *optimum tails assay*, or that assay which results in the lowest cost for enriched product for a particular utility's fuel economics. (Reports 195, 196, and 197 [November 1984 through January 1985] contain a three-part article on the Optimum Tails Assay.)

Prior to the issuance of the USEC, two basic enrichment contracts were in effect. The Requirements-type contract allowed a utility to specify the quantity of SWUs desired in a given year with as little as 180 days notice. The Adjustable, Fixed-commitment (AFC) contract specified fixed quantities of SWU that had to be taken in each year of the contract. Because from DOE's standpoint the AFC contract was essentially less risky than the Requirements contract, the price per SWU under the AFC contract was historically below the price per SWU under the Requirements contract. When the USEC was issued, DOE set a number of terms for converting the old contracts to the USEC, and other terms were negotiated by the individual utilities. As a result, depending on each utility's previous contract, its duration and the utility's negotiations with DOE, some utilities were left with fixed commitments for FY84, FY85, and FY86.

Therefore, despite the overwhelming acceptance of the USEC, which is basically a Requirements-type contract, some utilities still had fixed commitments to take through FY86. In addition, following many plant cancellations during the 1970s and early 1980s, many utilities became oversupplied with uranium and SWUs. The tails assay swap worked best for those utilities that were both overcommitted and had further fixed commitments. Moreover, to use the technique the utility had to be able to specify any tails assay between 0.2 and 0.3 w/o. The following example shows how a utility could take its fixed-commitment SWU delivery, vary its tails assay and supply additional feed, and realize a profit on the secondary-market sale of the SWU component in the excess enriched product.

Scenario

Assume that Utility A has a fixed-commitment delivery for 100,000 SWU and specifies 3.0-percent enriched product. Because of high feed costs, Utility A specifies a tails assay of 0.2 w/o, to reduce the amount of feed it must supply. With the parameters of

— 100,000 SWU,
— 0.2 w/o tails assay,
— and 3.0 w/o product enrichment,

Utility A would have to deliver 127,244 kgU as natural UF_6 to DOE and would in turn receive 23,224 kgU as UF_6 enriched to 3.0 w/o.

In order to exploit the tails assay swap technique, Utility A could instruct DOE to change the tails assay to 0.3 w/o. Utility A would need to deliver more feed, but would receive from DOE a greater amount of enriched product. With 100,000 SWU, 3.0 percent enrichment, and *0.3 w/o tails assay*, Utility A would deliver 191,795 kgU as UF_6n, and would receive 29,197 kgU as UF_6e. In essence, Utility A must obtain 64,551 kgU as UF_6n *in additional feed* in order to acquire an excess of 5,973 kgU as UF_6e of enriched product (Figure 2).

At this point, Utility A could use an intermediary to acquire the extra 64,551 kgU of natural feed needed for the 0.3 tails

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BASIC CONSIDERATIONS

Utility A (at 0.2 tails)	Utility A (at 0.3 tails)
100,000 SWU + 127,244 kgU as UF_6n = 23,224 kgU as UF_6e	100,000 SWU + 191,795 kgU as UF_6n = 29,197 kgU as UF_6e

Change from 0.2 tails to 0.3 tails

FEED DEFICIT	PRODUCT SURPLUS
64,551 kgU as UF_6n	5,973 kgU as UF_6e

39,237 kgU as UF_6n + 20,458 SWU

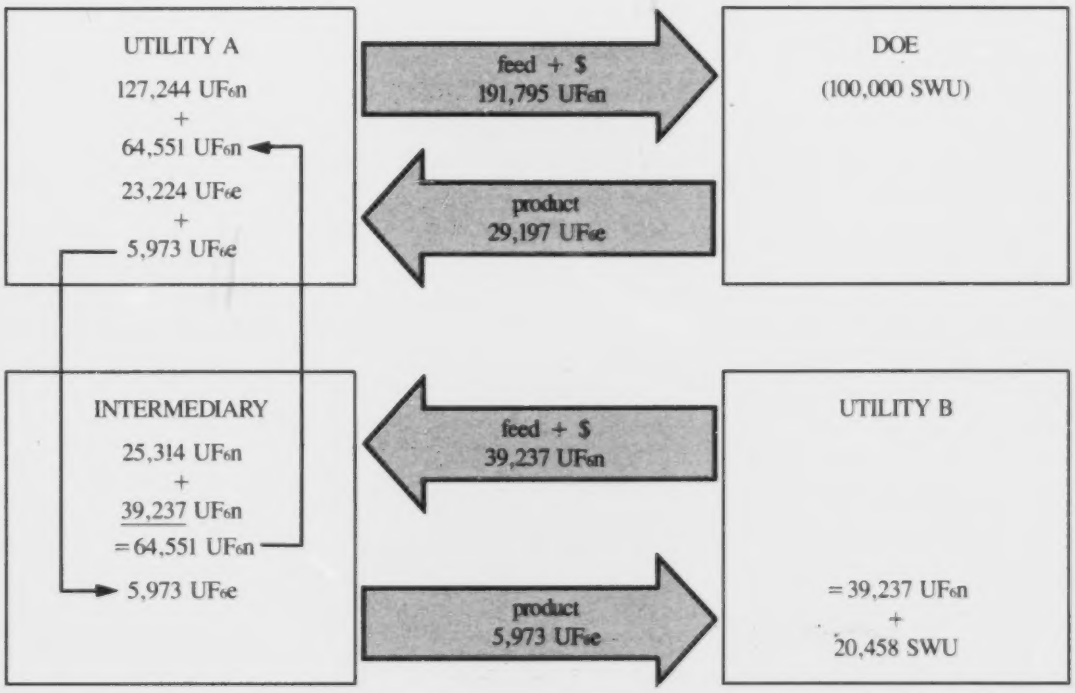

Figure 2. SCHEMATIC OF A HYPOTHETICAL TAILS ASSAY SWAP.

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assay, in exchange for the extra 5,973 kgU of enriched product that will result from the higher tails. Utility A is indifferent, still having purchased the 100,000 SWU required under its contract with DOE, and having delivered the same amount of feed that it had planned to deliver at 0.2 w/o tails assay. At 3.0 percent enrichment and 0.3 tails, the 5,973 kgU of excess enriched product contains

— 39,237 kgU of natural feed, and
— 20,458 SWU.

The intermediary then approaches Utility B, offering to sell it 20,458 SWU (contained in the excess enriched product) at 0.3 w/o tails. Utility B delivers the appropriate feed component (39,237 kgU as UF_6n), plus the sales price of the SWU component.

To determine the price at which to sell the SWU to Utility B, the intermediary must consider what the cost will be to purchase the extra feed needed to supply Utility A; in other words, the cost of buying the feed not provided by Utility B.

64,551 kgU needed for Utility A
− 39,237 kgU supplied by Utility B
= 25,314 kgU that must be purchased by intermediary.

Assuming the intermediary could obtain the remaining feed for $55.00 per kgU, then

(25,314 kgU)($55.00/kgU) = $1,392,270

$1,392,270 / 20,458 SWU = **$68.06 per SWU**

In this example, then, the $68.06 per SWU represents the breakeven price for the intermediary. However, if feed costs rise to $60 per kgU of UF_6n, then

(25,314 kgU)($60.00/kgU) = $1,518,840

$1,518,840 / 20,458 SWU = **$74.24 per SWU**

and the breakeven SWU price rises to $74.24 per SWU.

Obstacles to the Technique

The chief reason that tails assay schemes are becoming extinct is the terms and conditions of the USEC. Because it essentially is a Requirements-type contract, the USEC does not obligate utilities to take a fixed amount of SWUs each year for the duration of the contract. Thus, those utilities that converted their old AFC and Requirements contracts to the USEC will, under most circumstances, purchase the least amount of SWUs possible to enrich their feed by specifying 0.3 w/o tails assay. Moreover, most fixed commitments left over from the AFC contracts that were converted to the USEC ended in FY86. Unless a utility is under contract to accept substantially more SWUs each year than it might need, there is little motivation to become involved in a tails assay swap. Moreover, as primary (and, by extension, secondary) market prices for SWUs decrease *relative to the price of natural UF_6*, the breakeven price of the SWU component contained in the excess enriched product moves closer to secondary market SWU prices, reducing the profit margin in the transaction.

CORRECTION

Two errors in the Nuclear Electric Generating Capacity article in last month's Report (September 1986, #217, page 10) warrant correction.

1. In the section on Spain, the text states that five plants under construction were canceled by the government in 1984. In actuality, those units were *deferred*, a critical distinction in that engineering and some construction work is continuing at several of the sites. As shown in Table 2B of the article, Nuexco's forecast predicts that several of the deferred units will be reinstated in the government's energy plan for the 1990s.

2. Belgium's seven operating nuclear plants account for *50 to 80 percent* of the country's electricity production, as opposed to the figure of 80 percent stated in the article.

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RECENT DEVELOPMENTS

SOUTH AFRICA

The Atomic Energy Corporation of South Africa Limited (AEC), recently released a report entitled "Uranium in South Africa 1985." The report, formerly issued under the auspices of NUCOR (Nuclear Development Corporation of South Africa), contains the updated official assessment of South African uranium resources and production capabilities. (In 1985, NUCOR and UCOR [Uranium Development Corporation of South Africa] were consolidated under the leadership of the AEC.) The report includes the latest official evaluation of trends in uranium exploration, production and prices, as well as discussions of geology and national policy matters.

Although the confidentiality of such information is closely guarded in South Africa, terms of the Nuclear Energy Act of 1982 provide for the release of certain data to the AEC, which summarizes that information and publishes it in a biennial report. The report contains some of the most comprehensive information available regarding the South African uranium industry.

As in past reports, the AEC reassessed the country's uranium resource potential, expressing the total recoverable resources and their associated costs in terms of Reasonably Assured Resources (RAR) and Estimated Additional Resources (EAR). In essence, RAR refer to uranium that occurs in deposits known to facilitate recovery within given production cost ranges (less than $80 per kgU and $80 to $130 per kgU) using current technology. Category 1 of EAR refers to uranium that is expected to occur in extensions of known deposits, but where specific data to classify the resource as RAR is inadequate.

Table 2 summarizes the AEC findings during 1985. The AEC estimated that as of January 1, 1985, South African resources in the RAR and EAR-1 categories, recoverable at costs less than $130 per kgU ($50 per pound U_3O_8), totaled 483,300 metric tons uranium (1.256 billion pounds U_3O_8). This figure represents an increase of five percent from the January 1983 figure of 460,000 MTU. Extensive exploration in the Witwatersrand Basin contributed to the 23,000 MTU increase, as did the decline of the dollar relative to the rand, which effectively lowered mining costs in dollar terms, moving certain resources into lower cost categories.

The AEC reported production statistics of 5,732 MTU (14.9 million pounds U_3O_8) in 1984, declining 15 percent to 4,880 MTU (12.7 million pounds U_3O_8) in 1985. The decline was generally attributed to poor market conditions for uranium, despite the fact that most of South Africa's uranium production is committed to long-term contracts.

Other notable items in the AEC report include the following:

1. All of the nation's uranium is produced as a by-product, mostly of gold production in the quartz-pebble conglomerates of the Witwatersrand Group, of which the Central Rand Group is believed to contain 87 percent of South Africa's uranium resources in the lower-cost categories. A small amount (185 MTU, or about three percent of the nation's total in 1985) is produced as a by-product of copper mining at Palabora Mining Company's open-pit mine.

2. South Africa supplied 13 percent of the world's uranium in 1985, second only to Canada.

3. The country holds 14 percent of the world's resources in the RAR and EAR-1 categories, exploitable at costs less than $130 per kgU, second to Australia.

UNITED STATES

An article in Report 217 (September 1986, page 22) examined various legislative measures introduced in the US Congress, all of which could have a significant impact on the international nuclear fuel industry. Near the end of September, a bill concerning sanctions against South Africa (S. 2701) moved through the legislative process with strong support, and was placed before President Reagan for his signature. Among other provisions, the bill would prohibit imports of South African uranium ore or uranium oxide into the United States. On September 26, Reagan vetoed the measure, as had been expected. Shortly thereafter, as Congress mobilized in an attempt to override the veto, Reagan offered to invoke new sanctions by executive order. The proposed executive order would have prohibited the import of South African iron and steel, but apparently not uranium. However, the House of Representatives voted 313-83 to override the veto and thereby effectively rejected the President's last-minute offer.

Shortly after the House vote, the Senate voted 78 to 21 to override the veto, making the bill a law despite opposition from the President. However, the vague language contained in certain provisions will leave much of the law to interpretation by the Executive Branch. Those ambiguities may have been drafted deliberately to assure the bill's passage. Nevertheless, it is uncertain whether imports of South African uranium in any form will be allowed, or whether such import limitations are applicable to non-US entities that intend to remove the uranium at a later date. DOE can be expected to lobby for a lenient interpretation of the language, since some of its non-US enrichment customers have contracts with South African suppliers. Those customers would be forced to divert that material to DOE's competitors in Europe. In addition, there is a question whether companies will be allowed to import UF_6 into the USA. The language of the law does not specifically *prohibit* the importation of UF_6, but that issue may well be decided by the agency designated to interpret the law.

At present, it appears that more than one government agency may have jurisdiction in the interpretation of the law, including the

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Table 2

SOUTH AFRICA'S URANIUM RESOURCES IN THE RAR AND EAR-1 CATEGORIES[1] AS OF JANUARY 1, 1985, AND JANUARY 1, 1983[2] (Expressed in metric tons U)

Principal Deposits or Provinces	Reasonably Assured Resources (RAR)[3]		Estimated Additional Resources (EAR)[4]		Percent of Total[5]
	$0-$80/kgU	$80-$130/kgU	$0-$80/kgU	$80-$130kgU	
Witwatersrand Basin Conglomerates	199,300 (163,000)	55,000 (50,000)	90,600 (98,000)	25,100 (43,000)	77 (77)
Witwatersrand Basin Tailings	34,100 (22,000)	16,700 (21,000)	— (—)	— (—)	11 (9)
Palabora	5,500 (2,000)	— (—)	— (—)	1,600 (—)	2 (1)
Karoo Sequence	17,700 (4,000)	29,700 (50,000)	6,900 (1,000)	— (5,000)	11 (12)
Surficial	— (—)	700 (1,000)	— (—)	400 (—)	0 (1)
TOTAL RESOURCES	256,600 (191,000)	102,100 (122,000)	97,500 (99,000)	27,100 (48,000)	(100)

[1]Exploitable at costs of less than $130/kgU.

[2]Estimates as of January 1, 1983 are shown in parentheses.

[3]Reasonably Assured Resources (RAR) refers to uranium that occurs in known mineral deposits of such size, grade and configuration that it could be recovered within the given production cost ranges with currently proven mining and processing technology. Estimates of tonnage and grade are based on specific sample data and measurements of the deposits and on knowledge of deposit characteristics. Reasonably Assured Resources have a high assurance of existence and in the cost category below $80/KgU are considered as *reserves* for the purposes of this table.

[4]Estimated Additional Resources-category 1 (EAR-1) refers to uranium in addition to RAR that is expected to occur, mostly on the basis of direct geological evidence in extensions of well-explored deposits and in deposits in which geological continuity has been established but where specific data and measurements of the deposits and knowledge of the deposits' characteristics are considered to be inadequate to classify the resource as RAR. Such deposits can be delineated and the uranium subsequently recovered, all within the given cost ranges. Estimates of tonnage and grade are based on such sampling as is available and on knowledge of the deposit characteristics as determined in the best-known parts of the deposit or in similar deposits. Less reliance can be placed on the estimates in this category than on those for RAR.

[5]Column may not add due to rounding.

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Department of Commerce, the Nuclear Regulatory Commission, the Department of State, and the US Customs Department. There have been no statements as to which of those bodies has jurisdiction, nor has there been any comment from those agencies, many of which have not yet seen the legislation. A most important issue which will certainly be raised is whether, in the interests of free trade and foreign relations, non-US companies will be allowed to bring South African uranium into the USA for conversion or enrichment as long as the material is destined for use in another country.

* * *

Both sides in the US uranium producers versus DOE lawsuit presented oral arguments September 11 in the Tenth Circuit Court of Appeals in Albuquerque, New Mexico. Although observers had speculated that the proceedings might give an indication as to how the three judges would rule, there were no surprises from either the litigants or the court in what amounted to a routine hearing. The presentations by counsel for the producers and DOE, each lasting approximately 30 minutes, largely followed their respective appeal briefs submitted previously. The hearing chiefly served as an opportunity for the court to ask questions of counsel in areas of the case that needed explanation or elaboration. Despite the expectations of many market participants, the hearing provided no reliable indication as to the eventual outcome of this case.

Although the appeal covered the District Court ruling on Count I (pertaining to enrichment of foreign uranium) as well as Count II (pertaining to the Utility Services Enrichment Contract [USEC]), the emphasis of counsel and the court was clearly on Count I. Nevertheless, DOE counsel did make several points regarding Count II. Some of the main points brought up by the court and the counsel on both counts are summarized as follows.

1. DOE opened by arguing that the producers, since they are not customers of DOE and were not injured by the issuance of the USEC, did not have "standing," or grounds, to challenge the contract. If the appeals court determines that the issue of standing was not properly addressed in the District Court, the issue may be remanded (returned) to the District Court.

2. DOE maintained that the USEC, although it represented a substantial change in the way DOE marketed its enrichment services, was entirely within the boundaries of the existing enrichment criteria. Counsel stated that the producers' complaint against the USEC was "an ill-chosen vehicle designed to coerce DOE into changing long-standing policies that have nothing to do with the Utility Services Contract."

3. Regarding the imposition of limitations on the enrichment of foreign-origin uranium for use in US plants, DOE stated that the statutory language of section 161(v) of the Atomic Energy Act was the only relevant issue. DOE disagreed with the producers' contention that *if* the industry is nonviable, *then* DOE must restrict the enrichment of foreign-origin uranium. DOE believes that this is true "when and only when such measures will assure the viability of the US uranium industry." According to DOE's study, such measures will *not* assure that viability, and restrictions would only harm DOE's competitiveness in the world market for enrichment services.

4. The court asked DOE counsel whether DOE was not in fact required by the statute to "do something" when the US uranium industry became nonviable. DOE counsel responded that it is only required to make an annual report of viability to Congress, implying that it is Congress' responsibility to pass legislation to assist the industry. Moreover, it is DOE's position that imposing restrictions on the enrichment of foreign-origin uranium would not help the domestic producers. Finally, DOE claimed that its interpretation of the statute is at least as reasonable as the producers' interpretation.

5. Counsel for the producers argued that DOE has the mandate to impose enrichment limitations at any time, and has done so in the past. Moreover, the nonviability determination acts as a trigger that should have caused DOE to implement restrictions immediately in support of the domestic industry.

6. The producers' counsel also maintained that a 100-percent restriction on the enrichment of foreign uranium for use in US plants would increase the demand for US-origin uranium, thereby significantly bolstering the US production industry in a relatively short time. In summary, he stated that DOE should not be allowed to ignore a Congressional mandate to support the US uranium production sector.

At this stage, the Circuit Court of Appeals may take any of a number of possible actions. Certain issues may be remanded to the District Court for further findings, any or all of the District Court's order may be upheld, or the entire case may be overturned. If the District Court ruling is substantially upheld, DOE may well petition the US Supreme Court for a review. However, the Supreme Court may refuse to hear the case, at which point DOE's judicial options would be exhausted. In any event, some decision from the Circuit Court is expected before the end of the year, although the decision itself may not indicate the exact outcome of the case.

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THE OLYMPIC DAM PROJECT: PROGRESS REPORT

Introduction

Construction of commercial production facilities at Australia's Olympic Dam (Roxby Downs) multi-mineral deposit began in March 1986, over a decade after mineralization was discovered by Western Mining Corporation Ltd. (WMC) on a mineral lease that includes part of the Roxby Downs pastoral station in South Australia. Subsequent exploration and delineation drilling revealed mineable reserves of copper, uranium, gold, and silver. Indeed, it is one of the largest mineral deposits ever discovered, containing over two billion metric tons of ore with average grades of 1.6 percent copper, 0.06 percent U_3O_8 and 0.6 grams per tonne (g/t) of gold. The deposit covers an area of approximately 20 square kilometers, and further delineation using surface drilling techniques is continuing. Nuexco Report 184 (December 1983, page 27) contains details of early project activity and geologic information.

WMC, through its wholly-owned subsidiary Roxby Mining Corporation Pty. Ltd., controls 51 percent of the project, and the BP Group controls the remainder — 36.5 percent through BP Australia Ltd., and 12.5 percent through BP Petroleum Development Ltd. Capital expenditures from the project's beginning through March 5, 1986 totaled A$192 million. Commitment to a full-scale construction project required the partners to appropriate approximately A$560 million in additional capital funding for the initial projects. The schedule calls for annual production of 30,000 tonnes of refined copper, 5.2 million pounds of uranium oxide (U_3O_8), and about 90,000 ounces of gold. The first copper, uranium and gold production is scheduled for mid-1988.

The project, as originally conceived, was based on annual copper production of 150,000 tonnes, which could be associated with about 4,000 tonnes of U_3O_8; no decision has been made at present as to the timing of expansion to these production levels, which will be arranged to meet market opportunities. The first expansion will increase copper production to about 55,000 tonnes annually. Gold production will be a function of annual ore throughput.

The partners' commitment to the initial project was based on its viability as determined in late 1985. Since then, expected revenue has been enhanced by rising gold prices and a substantial decline in the Australian dollar relative to most other major currencies. Subsequent expansion of production will be determined in light of market opportunities at the time.

Metallurgical processing facilities to be constructed will include a concentrator, smelter and refinery for copper production, a hydrometallurgical plant for uranium extraction and recovery, and a gold plant for the production of gold bullion. On-site support facilities installed for the pilot-testing stage of mining and processing will also be upgraded as necessary to meet increased production capacities. In addition, a townsite to accommodate about 3,000 persons will be constructed about 11 kilometers south of the mine area. The State Government will provide certain community facilities based on a population of up to 9,000 persons.

History of the Project

The project area is located at Olympic Dam, about 520 kilometers northwest of Adelaide in a remote semi-desert area of South Australia (Figure 3). The deposit is situated on the northwestern edge of the Stuart Shelf, a geologic feature that is known to host scattered occurrences of sulfide mineralization. Following more than ten years of research and exploration for copper in the historic copper mining region on Yorke Peninsula, south of Olympic Dam, WMC developed a model for sedimentary copper occurrences formed by the enrichment of groundwaters passing through basaltic rocks. The new exploration target became strata-bound copper deposits. Exploration efforts shifted northward in 1973, eventually concentrating on that portion of the Stuart Shelf west of the Flinders mountain range. Figure 3 shows the location of the project area, as well as some of the area's general geologic features.

The Stuart Shelf region was selected for copper exploration on the basis of favorable interpretation of a regional geophysical survey conducted by the Commonwealth Bureau of Mineral Resources and the South Australian Department of Mines and Energy. A number of potential target areas were selected for detailed evaluation based on individual gravity and magnetic anomalies caused by local and regional tectonic features. The Olympic Dam and Acropolis areas were selected for preliminary drilling to determine the geologic relationship to those geophysical anomalies. In July 1975, the first hole drilled on the Olympic Dam site encountered 38 meters of low-grade copper mineralization (1.05 percent Cu) at a depth of 353 meters. Later drilling performed at Acropolis also revealed low-grade copper mineralization, demonstrating the success of the geologic concept for strata-bound copper deposits.

At first, subsequent drilling was less encouraging. The next eight holes drilled were barren or indicated only marginal mineralization. The tenth hole, drilled in 1976, intersected 170 meters of mineralization containing 2.1 percent copper and over one pound of U_3O_8 per tonne. The extent of mineralization was generally defined following three years of wide-spaced drilling. The joint venture partnership was formed in July 1979, followed

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RAW MATERIALS

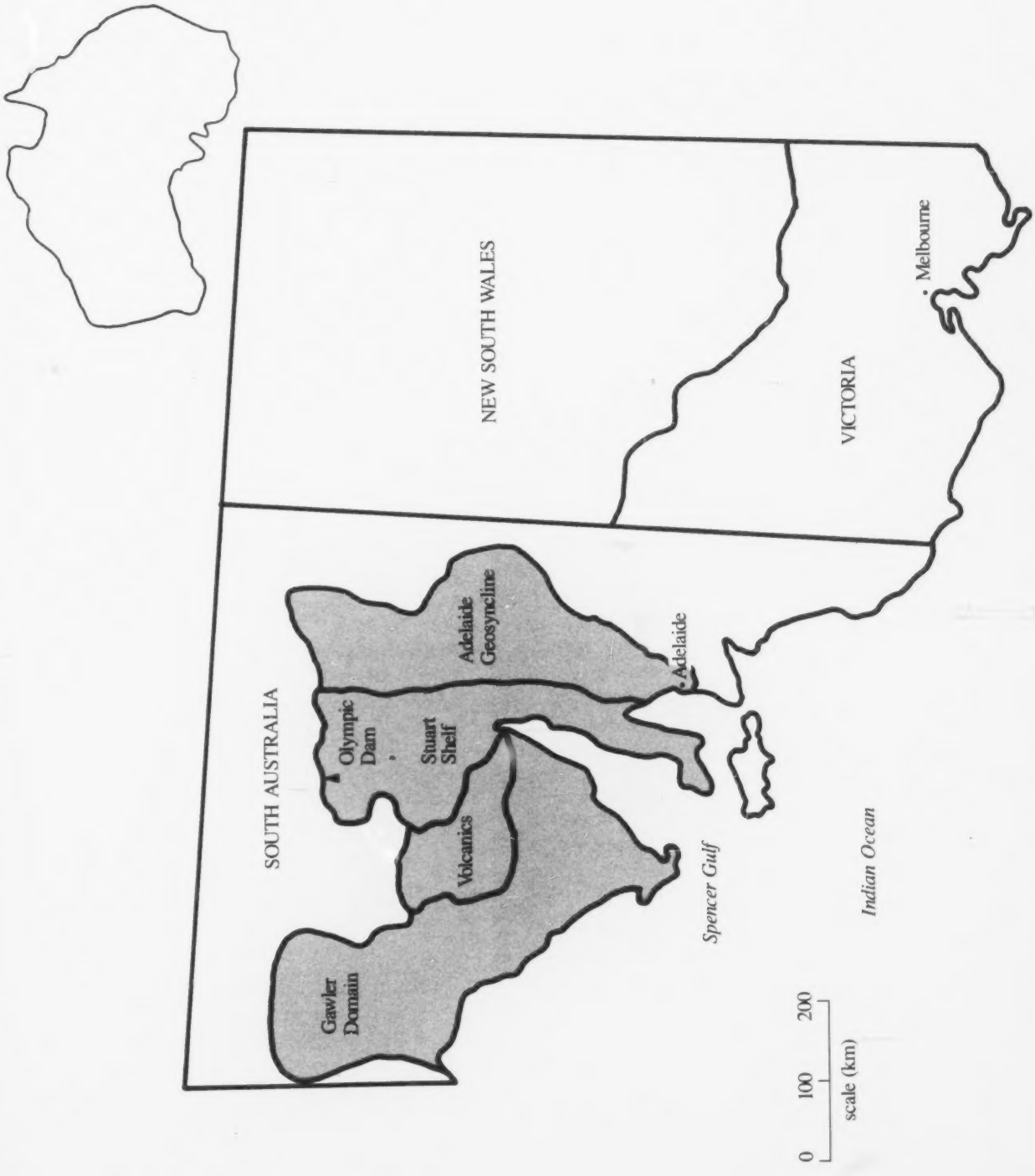

Figure 3. Olympic Dam location map, South Australia, showing relationship to prominent geologic features.

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immediately by more detailed delineation drilling of the ore deposit. Over 500 holes were drilled, ranging in depth from 600 to 1,300 meters, at an approximate cost of A$100 per meter. That drilling campaign identified a large internal high-grade mineral block estimated to contain about 450 million tonnes ore.

The partners decided in May 1980 to sink an exploration shaft to further evaluate the geology and overall characteristics of the deposit. The Whenan shaft (named after the driller of the discovery hole) was sunk to a depth of 500 meters and was in full operation by late 1982. Horizontal drifting, stope mining and long-hole drilling, primarily to complete delineation and supply metallurgical samples of the high-grade ore block, proved extremely successful. Over 1.2 million tonnes of ore and waste have been hoisted to the surface to date. Over 13 km of drifts, generally measuring 6 meters wide by 4.5 meters high, have been driven on three working levels to accommodate large equipment. Test mining is underway at numerous stopes, and over 1,100 long holes have been drilled, mostly in closely-spaced fan patterns above and below each drill station. The shaft and all underground work, including the location of workshops, supply and service areas, were designed to complement commercial development activity, although each facility may have to be upgraded to handle the increased capacities which are anticipated. Figure 4 illustrates a vertical cross-section of the Whenan shaft, showing the position of the three mining levels. Figure 5 indicates the large dimensions of development drifts.

Olympic Dam ore reserves, based on evaluation results of surface drilling, underground mining and long-hole drilling, were estimated in July 1982 and November 1983, as follows:

July 1982 estimate of total mineralized material based on surface drilling = 2,000 million tonnes containing:

Metal	Grade	Metal Content
Copper	1.6 percent	3.2 million tonnes
Uranium	0.06 percent	1.2 million tonnes
Gold	0.6 g/t	1.2 million kg
Silver	3.5 g/t	7.0 million kg

November 1983 estimate of probable ore reserves, high-grade block = 450 million tonnes (included in total resource estimate) containing:

Copper	2.5 percent	11 million tonnes
Uranium	0.08 percent	360,000 tonnes
Gold	0.6 g/t	270,000 kg
Silver	6.0 g/t	2.7 million kg

A 5-tonne per hour metallurgical pilot plant was built on site for testing ore to determine the optimum processing method and design parameters for commercial operations. The plant operated from March 1984 through November 1984, treating over 17,000 tonnes of ore taken from different locations throughout the mine. The pilot plant was equipped with conventional crushing, grinding and flotation circuits, producing over 1,400 tonnes of copper concentrates. Uranium was recovered via pressure leach and solvent extraction circuits, and precipitated as ammonium diuranate.

Roxby Management Services Pty. Ltd. (RMS), a wholly-owned subsidiary of WMC, is the project manager. RMS retained Fluor Australia Pty. Ltd. in July 1984 to study the technical aspects of the project for a full-scale commercial operation. The study was completed in March 1985, and covered resource evaluation, mining and processing procedures, support infrastructure facilities, construction and development costs, and efficiency requirements. RMS followed the technical study with its own feasibility study designed to determine the commercial viability of the project. That study focused on total financial

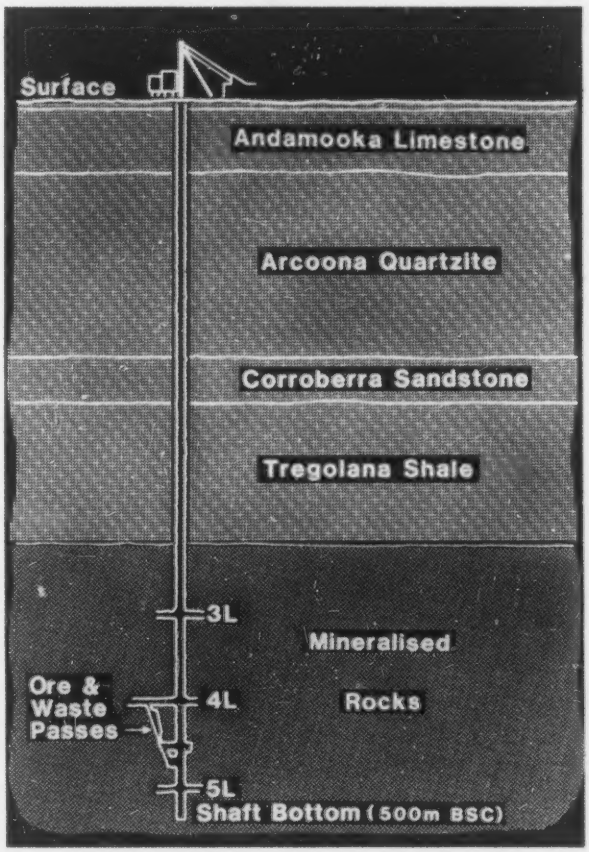

Figure 4. Vertical cross-section of the Whenan shaft.

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requirements based on sales revenue, cash flow, capital funding and debt servicing. The venture partners concluded from both studies that, within specific guidelines, the project was commercially viable; the deposit could be developed and minerals produced at competitive market levels, based on the combined values of both copper and uranium. Gold values provided added incentive. The partners announced in December 1985 that commercial development of the Olympic Dam deposit would proceed. Subsequently, development plans were finalized and approved by the partners, and construction began on March 6, 1986.

The Mine Development Program

The established production schedules for the Olympic Dam project require the simultaneous preparation of mining and processing capabilities, at extremely large capital expense. The development/construction program is scheduled in stages to accommodate increasing production levels over time. However, the schedule for expansion remains sensitive to economic changes. The markets for copper and uranium will be the key determinants to growth potential at Olympic Dam. The international commercial environment for both uranium and copper, as well as the uncertainties of political involvement with regard to marketing uranium, must be considered in advance of each expansion phase. Nevertheless, the partners have considered these uncertainties and have elected to proceed with project development.

The development plan, formulated following the successful pilot test program, was enacted in March 1986. In essence, the plan requires the simultaneous development of the ore deposit to accommodate large-volume mining, as well as the construction of ore processing facilities that will achieve the maximum recovery of contained metals. To facilitate efficiency, all project design and construction work is under the direction of RMS. Outside contract engineering and construction groups are carrying out the actual construction of the ore processing facilities. Mine preparation is the responsibility of the RMS operations staff.

Underground development work is progressing rapidly, as over 13 km of drifting has been completed on the three working levels

Figure 5. Underground drift development at Olympic Dam. Large drifts will accommodate high-volume mining equipment.

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off of the Whenan shaft (Figure 5). The initial mine plan involves exploitation of the probable ore reserves, containing over 450 million tonnes of high-grade material. However, the plan is only the first step in the long-term objective of mining and processing the 2,000 million tonnes of ore during the next 150 to 200 years. To accomplish such a long-range task in an efficient manner, the ore deposit was divided into eight parts, Mine Areas A through G, plus the Greenfield Formation (Figure 6). Each Mine Area boundary was arbitrarily established on the basis of geological and structural interpretation and the nature of mineral occurrence. Areas A through D were more thoroughly evaluated than the remaining areas, primarily because of higher mineral values encountered there. The "L"-shaped area between areas B and G is the Greenfield mine area, herein unofficially designated GR. It consists of the down-faulted portion of the graben occupied by the Greenfield Formation. The area contains low-grade mineralization not readily accessible to mining.

Initial project development, scheduled for completion by 1988, will facilitate production at an annual rate of 30,000 tonnes of refined copper, 5.2 million pounds of uranium oxide, and 90,000 ounces of gold per year. To accomplish and maintain this goal through the first three operating years, mine development will be accelerated to a production level of one million tonnes per annum (tpa) of copper/uranium ore, primarily from Mine Area D, with lesser tonnage mined from Areas A, C, and F as the development of each area is advanced. In addition, about 0.5 million tpa gold ore will be produced from Mine Area B. Another 0.5 million tpa of waste could be produced from new development work.

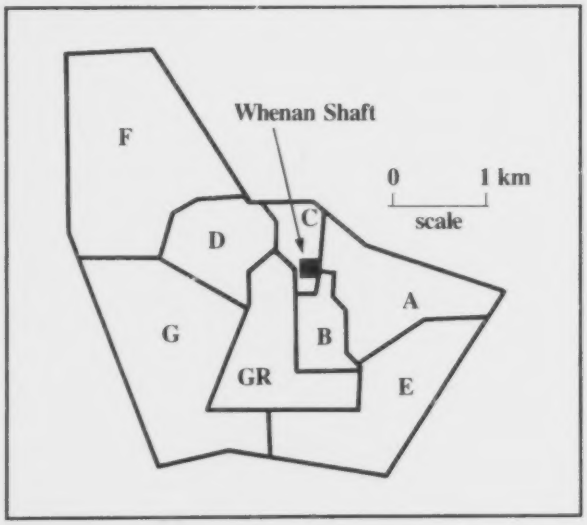

Figure 6. Plan map showing divisions of the project into specific Mine Areas.

Hoisting capacity of the Whenan shaft will limit production during the first three years. To overcome this problem, selective mining in Area D will yield ore averaging 3 percent copper and 0.13 percent U_3O_8; gold values as high as 5.0 g/t will be mined from gold-rich ore lenses scattered throughout parts of Mine Area B. The production ratio between copper-uranium ore and gold ore will be adjusted if necessary to meet production schedules and to take advantage of changes in ore grade and market opportunities.

Ore grades are expected to gradually decrease to the average level of the probable ore reserves during the early years of project development — 2.5 percent copper, 0.08 percent U_3O_8, and 0.6 g/t gold. Production of copper-uranium ore will be increased to 2 million tpa by that time to maintain the level of U_3O_8 production at 2,000 tpa and allow refined copper production to increase to about 55,000 tpa, as scheduled from the fourth year to the fifteenth year of the project. Ore production from Mine Areas A, C, and F will be increased to help meet tonnage requirements. A second shaft will be required for additional hoisting capacity by 1991. It will be designated Shaft #2, and will be located about 1,000 meters west of the Whenan shaft. The depth of the #2 shaft has not been determined, but early assessment indicates a depth of approximately 800 meters will be necessary to allow mining of the lower ore zones, presently unreachable from the Whenan shaft. Shaft #2 eventually will become the main production center, potentially having a hoisting capacity that exceeds 4 million tonnes annually.

Actual mining procedures will require the application of highly mechanized techniques. Large-volume mining is required to achieve production targets and to minimize operating costs. Usually, the thickness of ore will determine mining procedures. A large portion of the deposit consists of massive mineral zones exceeding 30 meters in thickness. Those zones will be mined by sublevel open-stope methods, whereby blasted ore will drop to a sublevel drawpoint for out-loading. A large portion of daily production will be mined by this method. Thinner ore zones will be mined by post-pillar stoping, which requires the development of a pillar sequence, followed by a systematic reduction of pillar size as retreat mining takes place. Broken ore will be loaded directly into trucks for removal to the hoisting center. All mined-out areas will be subject to backfilling in order to maintain ground stability. Waste rock may be used, but process tailings will be the main source of backfill material, and will be piped as a slurry from the surface directly to the fill area.

Metallurgical Process

Early laboratory and pilot plant testing revealed the complex nature of the Olympic Dam ore. The mineralization occurs in highly hematitic gangue material in host breccias. All contained minerals (copper sulfides, uranium oxides and silicates, gold,

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silver, and rare earths) occur as finely disseminated grains throughout the breccia matrix. The details for mineral recovery from the host environment were developed during pilot testing; the final flowsheet development and plant design was assigned to specialized consulting groups.

Construction of the various recovery circuits is well underway. The facilities will be built in module form to sustain planned expansion phases for the project. The first module constructed will be of sufficient capacity to process initial ore production of 1.5 million tpa. A second module will be required by the fourth operating year in order to process the 2.0 million tpa now planned. The need for additional modules will greatly depend on the grade of ore mined and market demand for Olympic Dam production. Figure 7 is a diagrammatic flow sheet of the metal recovery process.

The recovery process begins with ore preparation. Primary crushing occurs underground; the crushed ore will be hoisted to the surface and sent directly to the concentrator plant, where secondary (fine) grinding takes place in ball mills. From the secondary grinder, the ore is sent to the flotation circuit. The production of copper concentrates will take place utilizing conventional flotation, consisting of rougher cells and two-stage cleaner cells. Approximately 92 percent of the copper, 15 percent of the uranium, and 75 percent of the gold and silver in the ore feed will accumulate in the concentrate. Copper and uranium remaining in the flotation tails will be recovered in the hydrometallurgical plant, and the remaining precious metals will be recovered prior to tailings disposal. Concentrate from the flotation circuit then passes through an acid leach and reflotation circuit to produce a copper, gold and silver concentrate. Leached uranium will pass in solution to the uranium solvent extraction circuit. Gold and silver are separated from copper in a special gravity circuit and sent to the gold plant, and the copper concentrate, along with trace amounts of gold and silver, pass on to the smelter.

Extraction and recovery of uranium from the acid-leach solution and flotation tailings will take place in the hydrometallurgical plant. Pregnant solution from the leach and reflotation circuit will be comingled with pregnant solution generated from a separate flotation tailings leach circuit. The uranium-rich stream will pass through the solvent extraction circuit for concentration. Uranium will then be stripped from the aqueous solution with ammonium sulfate and precipitated as ammonium diuranate (ADU). The precipitate will be calcined at about 600 degrees C. in order to oxidize the ADU to uranium oxide (U_3O_8) prior to packaging. Soluble copper contained in the pregnant solution is removed as the solution passes through a separate solvent extraction circuit; it is recovered in the refinery as cathode copper by electrowinning, the process of electroplating.

High-grade copper concentrate containing abundant sulfides from the flotation circuit will be sent to the smelter for the production of blister copper. The final copper product produced at Olympic Dam will be cathode copper, produced in the refinery. Initially, the refinery module will have the capacity to produce 30,000 tonnes of cathode copper per year; a second module will be required to reach 55,000 tpa of copper metal. Gold and silver recovery is initiated in the flotation circuit, where about 75 percent of contained values are recovered. Gold and silver bullion is produced from the final concentrate.

Tailings from the metallurgical process will be disposed of in two separate environments. The main tailing stream will exit the processing system at the gold desliming circuit. The material will flow into four prepared retention areas. The discharge will be rotated continuously between four areas to allow settling and consolidation into a layered sequence of a high-strength, competent material which will withstand water and wind erosion. Secondly, the dewatered sands from the gold carbon-in-leach circuit will be delivered underground for backfill in mined-out areas. Each fill area will be barricaded to facilitate the build-up of a solid, compacted block, which offers limited support for a particular area and allows for minimized and controlled caving conditions.

Mineralization

The nature of mineral occurrence in the Olympic Dam deposit has been further revealed in the underground workings and in the cores from over 110,000 meters of long-hole drilling. The mineral suite, consisting of copper, uranium, gold, silver and rare earths, is contained in hematite-rich breccias of the Olympic Dam Formation, age dated Middle Proterozoic. The formation consists of sedimentary breccias, occupying the Olympic Dam graben, the main tectonic feature associated with the ore deposit. Mineralization shows concentration in zones of intense hematite, sericite, silica and chlorite alteration in the four upper members of the Olympic Dam Formation; the formation sequence above and below generally shows evidence of similar alteration patterns, but each is essentially barren of mineralization.

The upper portion of mineralization was previously thought to be contained in host rock designated as the Lower Silicified Member of the Greenfield Formation, directly overlying the Olympic Dam Formation. Underground observation revealed that no such stratigraphic member exists. In actuality, the sericite zone in the Upper Granite Breccia Member of the Olympic Dam Formation gives way to intense silification that extends upward into the Greenfield Formation.[1] Important mineralization is now

[1] *The Olympic Dam Copper-Uranium-Gold Deposit: II — New Developments*, OD30-11, 1986, D.E. Roberts and N.L. Godden, page 14.

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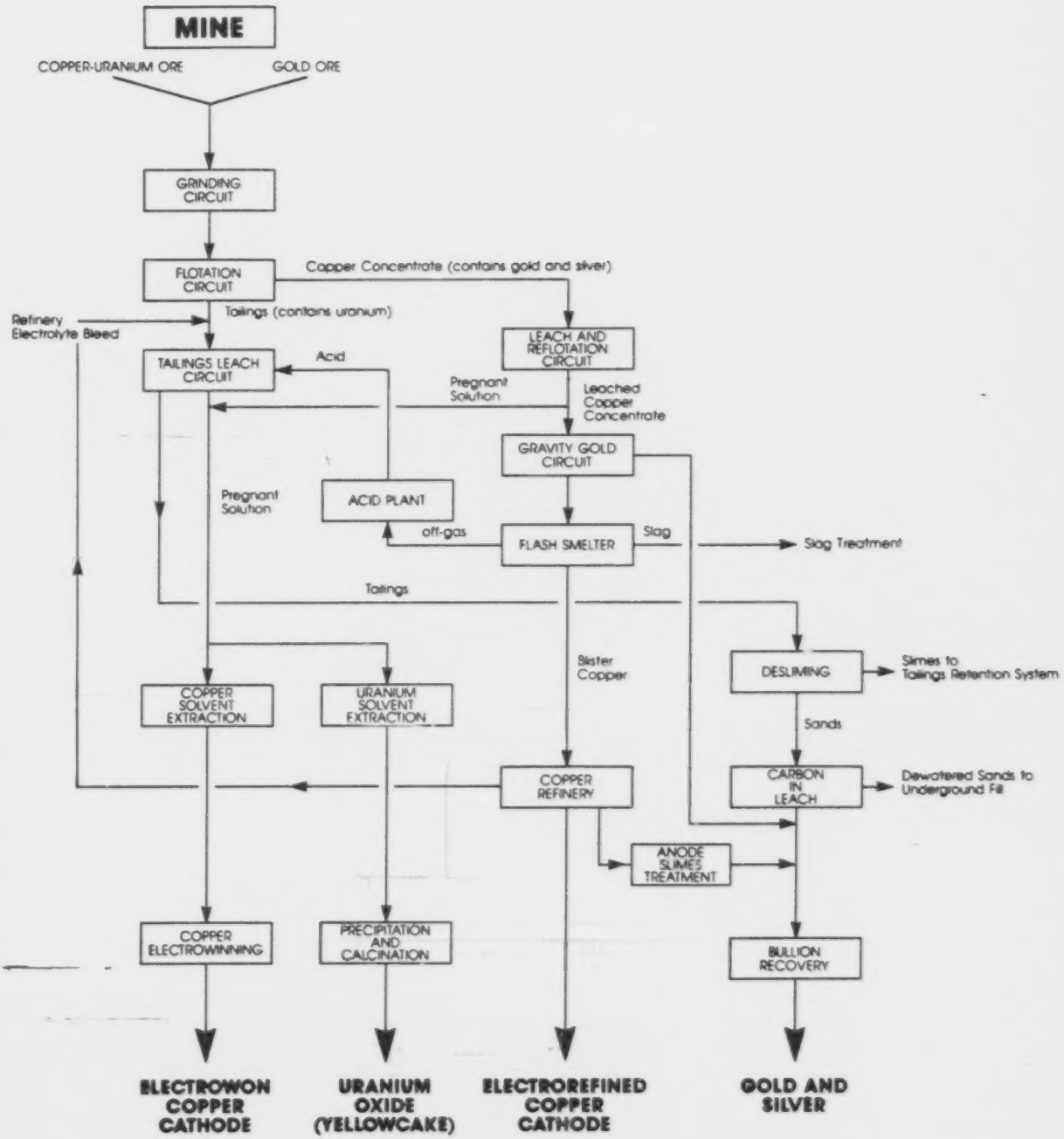

Figure 7. Flow sheet of mineral recovery process at Olympic Dam.

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considered to be confined to the four upper members of the Olympic Dam Formation, which are listed in descending order and described as:

Upper Granite Breccia Member (100 m thick)	Hematite-rich granite breccia, chalcocite and bornite minerals.
Brooks Member (300 m thick)	Mixed rock breccias, hematite-rich, chalcopyrite, bornite and chalcocite minerals.
Whenan Member (350 m thick)	Mixed rock breccias, bedded black and red hematite matrix, bornite and chalcopyrite minerals.
Black Hematite Member (150 m thick)	Black hematite breccias, altered and vuggy, chalcopyrite mineral.

It has become clear that the mineral zones vary considerably. Steeply dipping to nearly flat-lying zones are often discontinuous, ranging in thickness from less than one meter to over 50 meters. However, continuous zones may extend for hundreds of meters along both strike and dip dimensions. The flat-lying zones are often over 200 meters thick and cover hundreds of thousands of square meters in areal extent. Underground drilling has established many important characteristics of various mineral zones, especially the steeply dipping zones that are difficult to interpret from surface drilling results.

Two types of copper sulfide mineralization exist in the deposit. The types, designated strata-bound and transgressive, are based on the occurrence and distribution of sulfide minerals present, and other contained minerals are closely associated with either or both types. Occurrence by type is usually isolated and readily identifiable, but overlapping, lateral or vertical intrusions may occur, primarily in the vicinity of intrusive contacts and structural and alteration changes.

The most important and much more abundant mineralization occurs as strata-bound accumulations of bornite (Cu_5FeS_4) and chalcopyrite ($CuFeS_2$), with lesser amounts of chalcocite (Cu_2S). The minerals are fine-grained and evenly distributed throughout the matrix of the host breccia zones, making up 5 to 15 percent of the rock. The vertical thickness may exceed 350 meters. Intergrowths of chalcopyrite and pyrite with hematite make up the largest particles, often up to 5 cm in size. The mineralization is considered syngenetic, being deposited along with the material making up breccias as they occur in the two lower-mineralized members. The source of sulfide minerals may have resulted from geothermal activity associated with regional volcanism and igneous intrusions. Transgressive type mineralization is second in importance of occurrence. It consists of chalcocite and bornite sulfides which generally overlie the strata-bound mineralization. The source of mineralization is thought to be mineral-rich solutions migrating through the upper formations during late stages of the mineralizing event as it relates to intrusive activity and associated structural changes; thus, the sulfides are considered to be epigenetic. The age of sulfide mineralization has been estimated at about 1,580 million years.

Uranium minerals are disseminated throughout both types of sulfide mineralization as extremely fine-grained particles up to 0.1 mm in size. In strata-bound sulfide zones, uranium seems to be evenly distributed, whereas in transgressive zones it may form in uranium-rich veins and as segregations. The main uranium mineral present is uraninite (UO_2). It is almost ubiquitous throughout the sulfide zones. Coffinite [$U(SiO_4)$] occurs in close association, primarily in highly altered zones, as coating on fractures and veins, and as discrete grains of breccia matrix. Brannerite occurs spatially as vein-filling material limited to the Brooks Member. It is often associated with sericite and hematite alteration. Each brannerite grain is usually surrounded by a halo of rutile (TiO_2), forming an unusual mineral combination.

Free gold is lightly scattered throughout much of both sulfide zones with a slightly higher concentration in the transgressive ore zone. It also occurs well-disseminated in hematite-rich matrix, in microveinlets adjacent to sulfide zones, and in barite veins and silicified zones in granite breccias. The gold-rich zone (Mine Area B) occurs in a structurally disturbed area (highly fractured and sheared) within the Upper Granite Breccia Member of the Olympic Dam Formation, where it is in close contact with the eastern edge of the graben-confined Greenfield Formation. The gold mineralization overlies strata-bound copper-uranium and is separate from transgressive copper-uranium zones while occurring within the same stratigraphic sequence. Silver is associated with gold, but shows higher values in bornite-rich sulfide zones. It occurs as native silver and silver tellurides.

Two rare earth minerals, bastnaesite and florencite, occur in association with sericite, hematite, and fluorite in the breccia matrix. Combined, the minerals average 0.50 percent rare earths. The recovery of either mineral is currently not under consideration in overall project planning due to the extremely low grade.

Geology of the Region

The Olympic Dam project area is located in the northwestern part of the Stuart Shelf region, which is part of the Australian Shield complex. The oldest rocks in the region consist of Archean

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gneiss, schist and intrusives of the Gawler domain (Figure 3). The Stuart Shelf sedimentary sequence, which is Upper Proterozoic in age (Adelaidean), is about 350 meters thick. It overlies the basement rocks of the Gawler domain, the upper part of which consists of a Middle Proterozoic sedimentary sequence that includes the Olympic Dam Formation — host of the Olympic Dam ore deposit.

The eastern half of the Stuart Shelf is separated from the western half by the Torrens hinge zone, a major north-south trending fault system. Geologic structure east of the hinge zone is characterized by complex folding and faulting of basement rocks; west of the hinge zone the structural features consist of the Adelaide geosyncline and associated parallel folding. The major unconformity separating basement rocks from Adelaidean sediments masks basement structural features; thus, the presence of the Olympic Dam graben was revealed by drilling. The sedimentary breccias filling the graben indicate structural displacement of more than 600 meters.

The graben-filling breccias were deposited under contrasting conditions of rapid weathering and erosion, which accompanied extreme tectonic activity related to development of the graben. It was formed during the Kimban orogeny, which has been age dated at about 1,800 to 1,580 million years. The Stuart Shelf region has been geologically stable since the Kimban orogeny, so deep-seated structural features, including the graben and the mineral deposit, were unaffected by the long period of erosion preceding deposition of Stuart Shelf sediments.

Exploration drilling on three geophysical anomalies along the northwest part of the Stuart Shelf have resulted in the discovery of copper-uranium mineralization of Olympic Dam, Acropolis and Wirrda Well. A number of promising geophysical anomalies have yet to be tested. In addition, there is some correlation between the Mt. Painter copper-uranium deposit, located along the northeastern edge of the Stuart Shelf about 230 km east of Olympic Dam, and all three aforementioned deposits in geology and mineral occurrence. Based on this encouraging geologic evidence, the Stuart Shelf region has a large potential for additional mineral districts.

* * *

Nuexco wishes to acknowledge the cooperation of Roxby Mining Corporation Pty. Ltd. and BP Australia Ltd. in the preparation of this article.

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HISTORICAL MARKET DATA

EXCHANGE AND TRANSACTION VALUES
SINCE JANUARY 1980

Determined as of the last day of the month indicated

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HISTORICAL EXCHANGE VALUES

Determined as of the last day of the month indicated (US Dollars/lb. U_3O_8)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
1968	—	—	—	—	—	—	—	6.35	6.35	6.40	6.45	6.50
1969	—	6.35	6.10	6.10	6.25	6.25	6.20	6.20	6.15	6.15	6.15	6.20
1970	6.30	6.30	6.30	6.30	6.30	6.30	6.30	6.20	6.15	6.15	6.15	6.15
1971	6.20	6.20	6.20	6.20	6.15	6.05	6.00	5.95	5.95	5.95	5.95	5.95
1972	5.95	5.95	5.95	5.95	5.95	5.95	5.95	5.95	5.95	5.95	5.95	5.95
1973	5.95	6.00	6.10	6.20	6.45	6.50	6.50	6.50	6.50	6.50	6.75	7.00
1974	7.70	7.90	8.00	9.00	9.50	10.50	11.50	12.00	12.50	14.00	14.75	15.00
1975	16.00	16.00	18.00	20.00	21.00	23.00	24.70	26.00	26.00	28.50	30.00	35.00
1976	35.20	37.00	39.25	40.00	40.00	40.00	40.00	40.40	41.00	41.00	41.50	41.00
1977	41.35	41.50	41.60	41.60	42.00	42.25	42.25	42.25	42.40	42.75	43.20	43.20
1978	42.90	43.25	43.25	43.25	43.40	43.40	43.40	43.10	43.25	43.00	43.25	43.25
1979	43.25	43.25	43.25	43.25	43.25	43.00	42.70	42.70	42.20	42.20	41.00	40.75
1980	40.00	38.00	35.00	32.00	32.00	31.50	31.50	30.00	28.50	28.00	28.00	27.00
1981	25.00	25.00	25.00	25.00	25.00	24.25	23.50	23.50	23.50	23.50	23.50	23.50
1982	23.00	23.00	22.50	20.75	20.50	19.25	18.25	17.00	17.00	17.50	19.75	20.25
1983	21.50	21.75	22.25	23.25	23.50	23.50	24.00	24.00	24.00	23.50	22.50	22.00
1984	20.50	17.50	17.00	17.75	17.75	17.50	17.50	17.50	17.50	16.00	15.50	15.25
1985	15.00	15.00	15.00	14.25	15.00	15.00	15.75	16.00	16.00	16.50	16.75	17.00
1986	17.00	17.00	17.25	17.25	17.00	17.00	17.00	17.00	**17.00**			

HISTORICAL TRANSACTION VALUES

Determined as of the last day of the month indicated (US Dollars/lb. U_3O_8)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
1976	—	—	—	—	39.60	39.70	39.70	40.40	40.30	40.60	40.70	40.70
1977	41.30	41.30	41.40	41.50	42.80	42.90	43.00	42.60	42.50	42.80	42.90	42.90
1978	43.10	43.30	43.70	43.60	43.60	43.20	43.30	43.40	43.40	43.60	43.40	43.70
1979	43.60	43.80	43.70	43.40	43.60	43.70	43.70	43.60	43.60	43.60	43.50	42.30
1980	42.00	39.30	38.60	38.40	37.90	37.60	37.30	31.60	30.60	29.00	28.70	27.70
1981	27.20	27.20	27.00	25.70	25.70	24.50	24.40	24.30	23.90	24.10	24.10	24.00
1982	24.00	23.70	23.40	22.60	22.70	21.50	20.30	19.10	17.30	17.00	17.55	18.80
1983	19.35	20.00	21.35	21.40	22.35	22.45	23.50	23.60	23.65	23.65	23.85	23.85
1984	23.05	22.50	19.25	17.90	17.00	16.50	16.60	16.40	16.55	16.05	15.90	15.90
1985	16.20	15.70	15.05	14.90	14.45	14.60	14.75	15.10	15.10	15.75	15.80	16.55
1986	16.55	16.70	16.70	17.10	17.15	17.20	17.50	17.45	**17.35**			

HISTORICAL CONVERSION VALUES

Determined as of the last day of the month indicated (US Dollars/lb. U in UF_6)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
1981	1.20	1.20	1.20	1.40	1.15	1.15	1.15	1.10	1.10	1.10	1.20	1.20
1982	1.20	1.20	1.20	1.20	1.00	1.00	1.00	0.90	1.10	1.60	1.45	1.45
1983	1.20	1.40	1.40	1.20	1.20	1.20	1.10	1.10	1.00	0.60	0.60	0.60
1984	0.60	0.30	0.80	0.80	0.80	0.00	0.00	0.80	1.00	1.00	0.80	0.80
1985	1.00	1.00	1.00	1.50	1.50	1.60	1.60	1.60	1.60	1.60	1.60	1.60
1986	1.60	1.80	1.80	1.90	1.80	1.80	1.80	1.90	**1.90**			

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GOVERNMENT STATISTICS

AUSTRALIA

	Price Index of Materials Used in Manufacturing Industry — All Groups[1] (1984 = 100)	Award Rates of Pay Indexes Australia — Adult Males In Mining Wage Earners, Weekly Rates[2] (1976 = 100)
1975 Avg.	150.4	132.6
1976 Avg.	168.4	160.9
1977 Avg.	192.0	179.0
1978 Avg.[3 4]	198.5	190.0
1979 Avg.	248.8	127.9
1980 Avg.	321.8	140.8
1981 Avg.	355.3	154.1
1982 Avg.[5]	368.6	174.9
1983 Avg.	401.6	181.8
FY84 Avg.[6]	95.3	—
FY85 Avg.[6]	100.0	—
Jan 1985	97.0	197.8
Feb 1985	98.6	197.8
Mar 1985	102.1	197.8
Apr 1985	104.4	202.8
May 1985	107.6	202.4
Jun 1985	108.7	202.4
Jul 1985	111.1	202.4
Aug 1985	110.5	202.4
Sep 1985	108.9	202.5R
Oct 1985	108.7	202.4
Nov 1985	109.6	209.9R
Dec 1985	110.2	210.0R
Jan 1986	109.8	210.0R
Feb 1986	108.9	210.0R
Mar 1986	99.7	210.0R
Apr 1986	94.5	210.0R
May 1986	93.8	210.0R
Jun 1986	95.9P	210.0R
Jul 1986	—	214.7

P = Preliminary R = Revised since last month

[1]Australian Bureau of Statistics, Canberra: "Price Index of Materials Used in Manufacturing Industry" (Catalogue No. 6411.0). The basis of this index was revised to 1984 = 100. The previous index was 1969 = 100.

[2]Australian Bureau of Statistics, Canberra: "Award Rates of Pay Indexes, Australia" (Catalogue No. 6312.0). Figures for the latest fourteen months shown are subject to revision.

[3]Monthly data for 1970-78 appear on pages 4.7 and 4.8 of Report 138.

[4]Annual averages prior to 1979 reflect index base no longer in use.

[5]Monthly data for 1979-82 appear on page 35 of Report 184.

[6]Annual averages are for financial year ending June 30.

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CANADA

	Industry Selling Price Index: All Commodities[1] (1981 = 100)	Wage-earner Data: Average Hourly Earnings (C$)[2] Uranium Mines (SIC 057)	Metal Mines (SIC 051-059)	Mines, Quarries and Oil Wells[3] (SIC 051-099)	Primary Non-ferrous Metal Industries[4] (SIC 296)	(SIC 298)	Chemicals and Chemical Products[5] (SIC 372-379)
1979 Avg.[6]	217.9	—	9.60	9.66	—	—	7.67
1980 Avg.	247.2	—	10.58	10.80	—	—	8.50
1981 Avg.	288.7	—	12.02	12.23	—	—	9.53
1982 Avg.[7]	288.8	—	13.74	13.92	—	—	10.63
1983 Avg.	298.8	—	—	14.30	—	—	11.17
1984 Avg.	310.9	17.88	—	15.07	12.28	10.49	11.76
Jan 1985	117.5	18.05	16.13	15.60	12.32	10.80	12.04
Feb 1985	117.7	18.78	16.41	15.68	12.52	11.05	12.06
Mar 1985	118.4	18.24	16.21	15.57	12.44	10.97	12.02
Apr 1985	118.3	18.63	16.44	15.80	12.81	11.23	12.04
May 1985	118.6	19.41	16.51	15.63	12.76	11.25	12.15
Jun 1985	118.6	18.49	16.20	15.49	12.89	11.14	12.14
Jul 1985	118.6	18.14	16.27	15.41	12.96	11.17	12.13
Aug 1985	118.4	17.07	16.03	15.30	12.97	11.31	12.19
Sep 1985	118.6	18.53	16.55	15.72	12.95	11.39	12.26
Oct 1985	119.0	18.74	16.51	15.70	13.14	11.53	12.33
Nov 1985	119.3	19.05	16.66	15.88	12.76	11.32	12.49
Dec 1985	120.0	19.07	16.57	16.01	12.51	11.09	12.59
Jan 1986	121.0	18.15	16.22	15.86	13.11	11.48	12.52
Feb 1986	120.8R	19.52	16.57	15.99	13.20	11.59	12.45
Mar 1986	120.1R	19.04	16.65	15.93	13.11	11.59	12.54
Apr 1986	119.4R	19.38	16.68	15.95	13.07	11.64	12.54
May 1986	118.6R	19.54	16.68	15.78	13.16	11.72	12.51
Jun 1986	118.8R	19.80	16.63	15.60	13.04	11.77	12.42
Jul 1986	118.9P	—	—	—	—	—	—

P = Preliminary R = Revised since last month

[1]Statistics Canada, Prices Division, Ottawa: "Industry Price Indexes" (Catalogue 62-011). Indexes for the most recent six months shown are subject to revision. This category was formerly known as "Manufacturing." Index prior to 1985, 1971 = 100.

[2]Statistics Canada, Labour Division, Employment and Payrolls Section, Ottawa: "Employment, Earnings and Hours" (Catalogue 72-002).

[3]Reports 175 through 185 list this series title incorrectly as "Metal Mining, Including Milling (SIC 050-099)."

[4]Beginning with the April 1983 figure, Primary Metal Industries, non-ferrous is split into SIC 296 and SIC 298.

[5]Chemical and Chemical Products prior to April 1983 was SIC 370-379. The new series is from a new survey which includes all companies and is based on a 1970 classification. The old survey only included companies of 20 employees or more.

[6]Monthly ISPI for 1977 and 1978 appear on page 4.10 of Report 138, and monthly wage-earner data for 1973-78 appear on page 4.11 of Report 138.

[7]Monthly data for 1979-1982 appear on page 37 of Report 184. On that page, the wage earner index entitled "Metal Mining, Including Milling (SIC 050-099)" should read "Total Mining (SIC 051-099)."

[8]Beginning with the March 1983 figure, Wage Earner Data are based on a census of all companies employing 200 or more wage earners, *plus* a random survey of companies employing fewer than 200 wage earners. Prior to March 1983 only companies employing 200 or more wage earners are included in the Wage Earner Data.

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GOVERNMENT STATISTICS

REPUBLIC OF SOUTH AFRICA

		Average Declared Working Costs per Metric Ton of Gold Ore Milled (Rand)[1]	Tonnage-Weighted Index of Average Working Costs per Metric Ton of Gold Ore Milled (March 1982 = 100)[2]	Consumer Price Index[3] (1980 = 100)[4]	Producer Price Index All Groups[5] (1980 = 100)	Total Employment in Mining and Quarrying (Code 35)[6]	Total Salaries and Wages in Mining and Quarrying (1,000 Rand) (Code 40)[6]
1975	Avg.	16.71	—	157.2	100.0	639,473	1,003,617
1976	Avg.	19.30	—	174.7	115.1	671,240	1,212,983
1977	Avg.	23.87	—	194.4	130.0	712,006	1,420,670
1978	Avg.	27.14	—	137.2	142.7	664,571	1,537,169
1979	Avg.[7]	30.18	—	155.3	164.5	692,209	1,830,632
1980	Avg.[8]	35.53	—	176.7	192.1	714,379	2,279,615
1981	Avg.	41.89	—	206.5	218.3	728,506	2,820,505
1982	Avg.[9]	47.25	104.2	233.5	248.7	707,552	3,246,071
1983	Avg.	51.87	115.0	262.2	274.8	696,579	3,644,772
1984	Avg.	58.95	130.3	292.8	297.9	712,080	4,196,764
Jan	1985	—	—	177.1	166.6	711,366	376,777
Feb	1985	—	—	182.8	171.3	727,932	361,823
Mar	1985	64.48	142.4	183.6	173.0	708,809	371,380
Apr	1985	—	—	187.4	174.0	724,187	369,005
May	1985	—	—	189.5	177.7	708,085	373,478
Jun	1985	67.42	148.9	191.9	179.2	724,587	395,543
Jul	1985	—	—	193.6	180.7	738,228	419,106
Aug	1985	—	—	195.6	183.2	734,121	416,777
Sep	1985	70.47	155.3	197.8	184.8	732,836	419,883
Oct	1985	—	—	200.8	188.1	720,071	401,448
Nov	1985	—	—	203.4	196.0	750,049	432,996
Dec	1985	72.43	160.1	207.4	199.4	741,372	425,261
Jan	1986	—	—	213.8	203.6	744,070	449,513
Feb	1986	—	—	215.8	206.9	754,458	438,562
Mar	1986	75.76	167.8	218.3	206.9	759,897	445,387
Apr	1986	—	—	222.2	208.9	756,388	437,563
May	1986	—	—	222.6	212.5	754,788	425,544
Jun	1986	77.65	172.0	224.4	213.3	755,354	461,887
Jul	1986	—	—	228.8	216.3	—	—
Aug	1986	—	—	232.2	—	—	—

[1]Chamber of Mines of South Africa, Johannesburg; "Analysis of Working Results," published quarterly.

[2]Page 16 of Report 178 contains description and calculation of index, and page 24 of Report 178 lists figures for 1982.

[3]Republic of South Africa Department of Statistics, Pretoria; "Government Gazette: Consumer Price Index for Urban Areas."

[4]The basis for calculation prior to January 1985, 1975 = 100. For annual averages prior to 1978, April 1970 = 100.

[5]Previously known as the Wholesale Price Index, now the Producer Price Index. The computation remains the same. The basis for calculation prior to January 1985, 1975 = 100.

[6]Bulletin of Statistics, Department of Statistics, Pretoria.

[7]Historical data for the Average Declared Working Costs and Consumer Price Index 1970-1979 appear on page 4.9 of Report 140.

[8]Monthly data for Codes 35 and 40, 1977-1980, appear on page 28 of Report 157.

[9]Monthly data for 1979-82 appear on page 39 of Report 184.

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UNITED STATES

	Producer Price Index[1]		Consumer Price Index[2]	GNP Implicit Price Deflator[3,4]	Gross Average Hourly Earnings of Production or Non-supervisory Workers (US$)[5]			
	Industrial Commodities (1967 = 100)	All Commodities (1967 = 100)	(1967 = 100)	(1982 = 100)	Metal Mining (SIC 10)	Primary Non-ferrous Metals (SIC 333)	Chemicals and Allied Products (SIC 28)	Electric and Electronic Equipment (SIC 36)
1980 Avg.[6]	274.8	268.8	246.8	178.64	10.26	10.63	8.30	6.94
1981 Avg.	304.1	293.4	272.4	195.51	11.55	11.98	9.12	7.62
1982 Avg.[7]	312.3	299.3	289.1	207.15	12.33	12.94	9.96	8.21
1983 Avg.	315.8	303.1	298.4	215.63	12.57	13.43	10.59	8.65
1984 Avg.	322.6	310.3	311.1	108.1	13.05	13.43	11.03	9.04
Jan 1985	322.9	309.5	316.1	—	13.29	13.70	11.39	9.33
Feb 1985	322.5	309.2	317.4	—	13.30	13.73	11.39	9.33
Mar 1985	322.6	308.7	318.8	110.4	13.29	13.95	11.37	9.39
Apr 1985	323.8	309.3	320.1	—	13.43	13.63	11.47	9.40
May 1985	325.3	309.8	321.3	—	13.24	13.60	11.44	9.39
Jun 1985	324.8	309.2	322.3	111.3	13.23	13.68	11.51	9.46
Jul 1985	324.4	309.0	322.8	—	13.45	13.83	11.59	9.47
Aug 1985	323.7	307.3	323.5	—	13.55	13.71	11.60	9.50
Sep 1985	322.3	305.5	324.5	112.1	13.44	13.68	11.65	9.54
Oct 1985	324.2	307.9	325.5	—	13.49	13.66	11.70	9.55
Nov 1985	324.7	309.5	326.6	—	13.49	13.97	11.80	9.61
Dec 1985	325.1	310.2	327.4	113.0	13.43	13.81	11.85	9.68
Jan 1986	323.8	308.9	328.4	—	13.40	13.69	11.86	9.60
Feb 1986	318.9	304.4	327.5	—	13.44	13.82	11.81	9.60
Mar 1986	314.0	300.3	326.0	113.5	13.38	13.93	11.78	9.62
Apr 1986	311.6R	298.2R	325.3	—	13.54	13.87	11.82	9.62
May 1986	311.7	299.2	326.3	—	13.46	13.79	11.89	9.64
Jun 1986	311.6	298.9	327.9	114.2	13.52	13.49R	11.94R	9.61R
Jul 1986	308.5	297.7	328.0	—	13.47P	13.22P	12.05R	9.68R
Aug 1986	307.7	297.2	328.6	—	—	—	11.99P	9.66P

P = Preliminary R = Revised since last month

[1]US Bureau of Labor Statistics, Washington, D.C.: "Producer Prices and Price Indexes," (formerly "Wholesale Prices and Price Indexes"). Producer Price Indexes are revised four months after they are first released to reflect the availability of late reports and corrections by respondents.

[2]US Bureau of Labor Statistics, Washington, D.C.: Consumer Price Index for All Urban Consumers, US City Average, All Items.

[3]US Department of Commerce, Washington, D.C.: Bureau of Economic Analysis, National Income and Wealth Division: "Survey of Current Business." The GNP Implicit Price Deflator is published quarterly, and seasonally adjusted.

[4]The basis for calculation of this index was revised to 1982 = 100. 1984 and 1985 figures have been adjusted to that basis. The basis for calculation prior to 1984, 1972 = 100.

[5]US Bureau of Labor Statistics, Washington, D.C.: "Employment and Earnings." All data based on 1972 revision of SIC Manual. Data for 1970-1976 are adjusted to the March 1977 benchmark. Data for 1977-1978 are adjusted to the March 1979 benchmark. Data for January 1979 and beyond are adjusted to the March 1980 benchmark.

[6]Monthly data 1970-1978 for Producer Price Index-Industrial Commodities, Consumer Price Index, and Employment and Earnings SIC codes 10, 333, and 28, and quarterly data for GNP Implicit Price Deflator appear on pages 4.6-4.8 of Report 139.
Monthly data 1977-1978 for Employment and Earnings SIC Codes 10, 333, and 28 appear on page 33 of Report 147.
Monthly data 1970-1978 for Employment and Earnings SIC Code 36 appear on page 23 of Report 154.
Monthly data 1977-1980 for Producer Price Index-All Commodities, appear on page 21 of Nuexco Report 158.

[7]Monthly data 1979-1982 for all listed indices appear on page 41 of Report 184.

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